THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXXXVI. No. 2144.] LONDON, JUNE 14, 1904. [56TH YEAR. PRICE 6d.

PARKER & LESTER,

— ESTABLISHED 1830. —

MANUFACTURERS AND CONTRACTORS, **ORMSIDE STREET, LONDON, S.E.**

THE ONLY MAKERS OF

PATENT ANTIMONY PAINT & PARKER'S IMPERIAL BLACK VARNISH.

OXIDE PAINTS, OILS, AND GENERAL STORES, FOR GAS AND WATER WORKS.

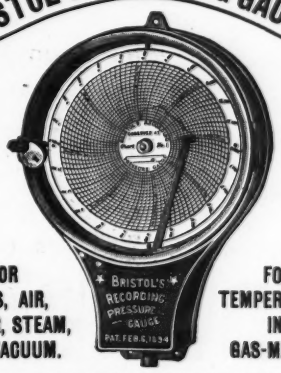
SAFETY GAS-MAIN STOPPER,

FOR SHUTTING OFF GAS IN MAINS TEMPORARILY DURING ALTERATIONS AND REPAIRS.

GAS-LEAK INDICATOR.

PRICES AND PARTICULARS ON APPLICATION.

BRISTOL'S RECORDING GAUGES

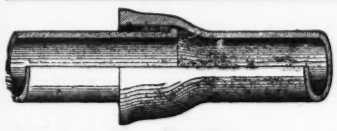


FOR GAS, AIR, WATER, STEAM, OR VACUUM.

FOR TEMPERATURE IN GAS-MAINS.

Many Thousands in Daily Operation.

J. W. & C. J. PHILLIPS,
23, COLLEGE HILL,
LONDON, E.C.



VERTICALLY CAST IRON PIPES.

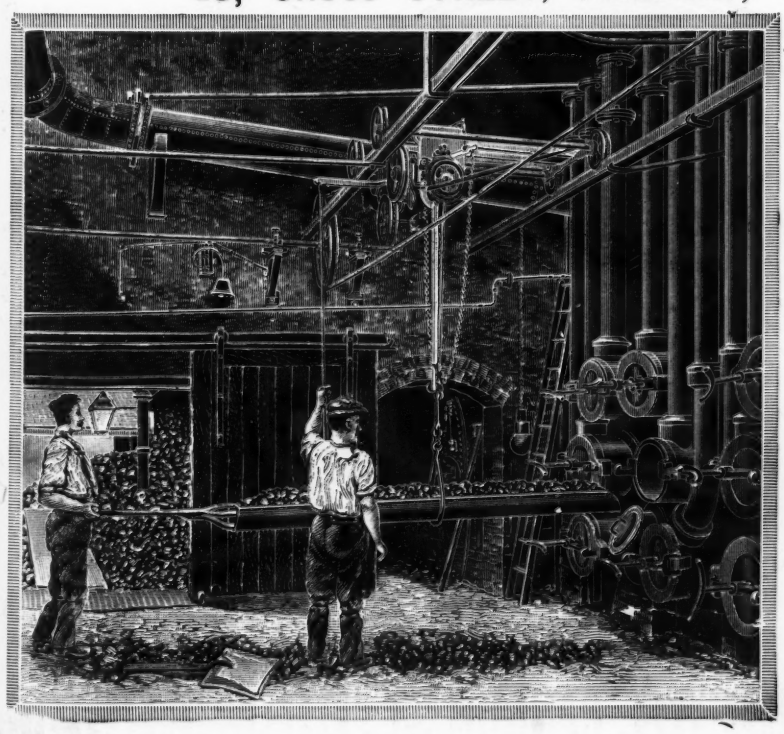
The only Foundry in Europe casting Pipes under Clarifying Process.

A. G. CLOAKE, 54, Holborn Viaduct, London, E.C.

Telegrams: "AMOUR, LONDON."
Telephone Nos.: 1890 HOLBORN; CENTRAL 194.

BIGGS, WALL, & CO.,

13, CROSS STREET, FINSBURY, LONDON, E.C.



Telegrams: "RAGOUT, LONDON."
Telephone: 273 CENTRAL.

"RAPID"
MANUAL & POWER
CHARGING APPARATUS,

FOR GAS-WORKS OF ALL SIZES.

Repeat Orders
YEOVIL, NEWPORT, SOUTHBANK, WORTHING, ALDERSHOT.

Machines can be seen working at any of the following Works:—

ALDERSHOT	WREXHAM
WORTHING	SWINDON
YEOVIL	EPSOM
TRURO	SHETTLESTON
NORMANTON	DUBLIN
OTLEY	G. S. & W. Rly. Works
GOOLE	NEWPORT, MON.

Great Reduction in the Cost of Purifiers

LUTELESS PURIFIERS

WORKED WITHOUT ANY CONNECTIONS AT ALL

(RAMSDEN & SMITH'S PATENT, No. 12,034.)

No complicated arrangement of Valves, each requiring separate manipulation.

No Internal Pipes interfering with Purifying Area.

Every part easily accessible.

FOR PRICES AND ALL PARTICULARS, APPLY TO THE MAKERS:

EDWARD COCKEY & SONS, LD.

Engineers and Contractors for Gas Plant of every Description,

FROME, SOMERSET.

Telegrams: "COCKEYS, FROME." — Telephone No. 16 FROME. — Telegrams: "DAMPER, LONDON."

London Office: BRIDGE HOUSE, 181, QUEEN VICTORIA STREET, E.C. Messrs. BALE & HARDY, Agents.

Contractors for all kinds of GAS-WORKS PLANT.

WE INVITE INSPECTION OF OUR **REGENERATIVE SYSTEM.**

PLANS, SPECIFICATIONS, AND ESTIMATES ON APPLICATION.

GAS ENGINEERS THE WINSTANLEY CO & CONTRACTORS

COMPLETE INSTALLATIONS OF INCLINED RETORTS.

RETORT BENCHES AND **SETTINGS,** WITH REGENERATOR, GENERATOR, OR ORDINARY FURNACES.

NEWTON CHAMBERS, CANNON ST., BIRMINGHAM.

THE BARROWFIELD IRON-WORKS, LIMITED,

GAS ENGINEERS & CONTRACTORS,

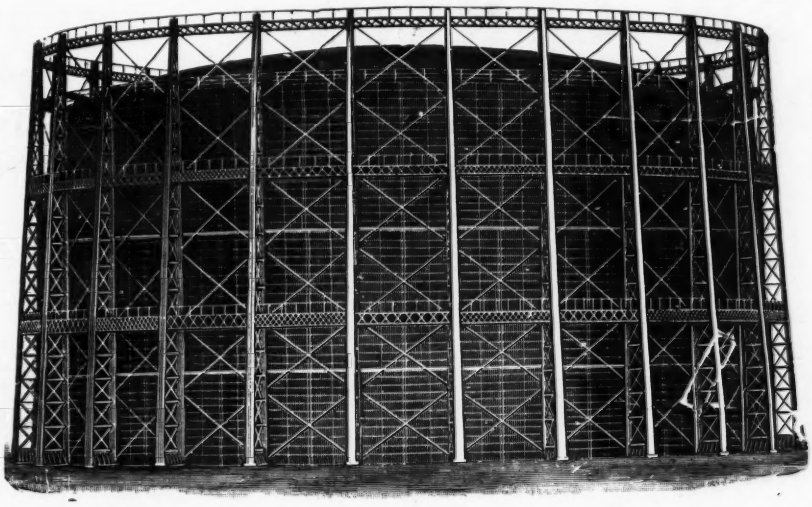
Telegrams: "GASOMETER GLASGOW." GLASGOW.

OIL PLANT AND CHEMICAL APPARATUS.

BRIDGES, GIRDERS WHARVES, PIERS.

ROOFING OF EVERY STYLE.

PIPES, VALVES, AND CONNECTIONS.



GAS APPARATUS OF EVERY DESCRIPTION.

RETORTS, CONDENSERS, SCRUBBERS, PURIFIERS.

GASHOLDERS AND TANKS.

ENGINES, EXHAUSTERS, STEAM BOILERS, AND FITTINGS.

THREE-LIFT GASHOLDER. Capacity, SIX MILLION cubic feet.
240 feet Diameter by 45 feet Deep each Lift. Erected at Glasgow, 1893.

London Office: 6, LITTLE BUSH LANE, CANNON STREET.

Wrought-Iron TUBES And Fittings & Accessories.

LAMBERT BROS., WALSALL,

MANUFACTURERS OF
WROUGHT-IRON TUBES & FITTINGS for GAS, WATER, & STEAM.
BRASS GAS-FITTINGS GAS-VALVES STEAM & WATER VALVES TOOLS. &c. AND OF
WARNER'S PATENT MARKET GAS STAND-PIPE.
LONDON: LAMBETH BRASS & IRON CO., LTD., 91 & 93, SOUTHWARK ST., S.E.

NEWTON, CHAMBERS, & CO.,

LIMITED,

THORNCLIFFE IRON-WORKS, NEAR SHEFFIELD.

Established 1790

LONDON OFFICE: 19, Great George Street, WESTMINSTER.

Telegraphic Addresses: "NEWTON, SHEFFIELD," "ACCOLADE, LONDON."

GAS ENGINEERS IRONFOUNDERS, & CONTRACTORS.

MANUFACTURERS OF EVERY DESCRIPTION OF

PLANT, APPARATUS, AND MACHINERY FOR GAS AND CHEMICAL WORKS.
RETORTS AND FITTINGS, MOUTHPIECES WITH SELF-SEALING LIDS.
IMPROVED COAL AND COKE HANDLING PLANT CONVEYORS AND ELEVATORS.
CONDENSERS, SCRUBBERS, AND WASHERS.

PURIFIERS with Planed Joints a Speciality.

PATENT CENTRE-VALVES, RACK AND SCREW VALVES, WOOD GRIDS AND SCRUBBER-BOARDS, CAST-IRON MAINS, AND SPECIALS.
STRUCTURAL WORK, COLUMNS, GIRDERS, AND ROOFING.
GASHOLDERS CAST-IRON OR STEEL TANKS.

DESIGNS, SPECIFICATIONS, and ESTIMATES FREE.

PIG IRON (SPECIAL QUALITY) for Engine Cylinders. GAS COAL famous for its unrivalled excellence.

GEORGE ORME & CO.

(BRANCH OF METERS LIMITED),

ATLAS METER WORKS,

Telegraphic Address: "ORME, OLDHAM."
Telephone No. 93, OLDHAM.

PARK STREET, OLDHAM.

"NEW CENTURY" IMPROVED PATENT COIN PREPAYMENT GAS-METERS

FITTED WITH DETACHABLE ATTACHMENTS.

ARRANGED FOR 1d., 6d., 1s., OR ANY OTHER COIN DESIRED.

These Meters are giving Universal Satisfaction wherever adopted.

GUARANTEED FOR FIVE YEARS.

Dry Meter in Tin-Plate Case, fitted with Attachment.

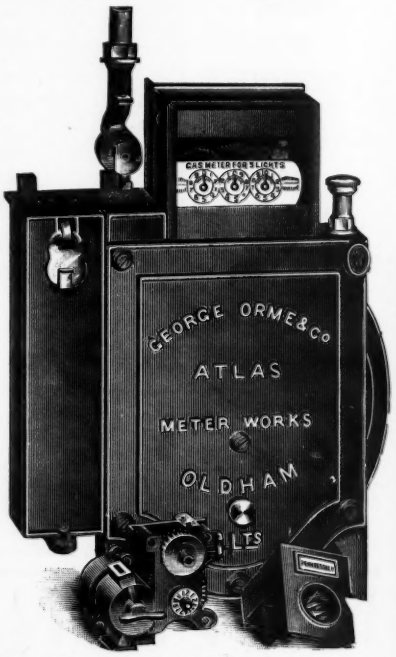
Price changed *in situ* by means of one Crown Wheel only.

COMPACT,

DURABLE,

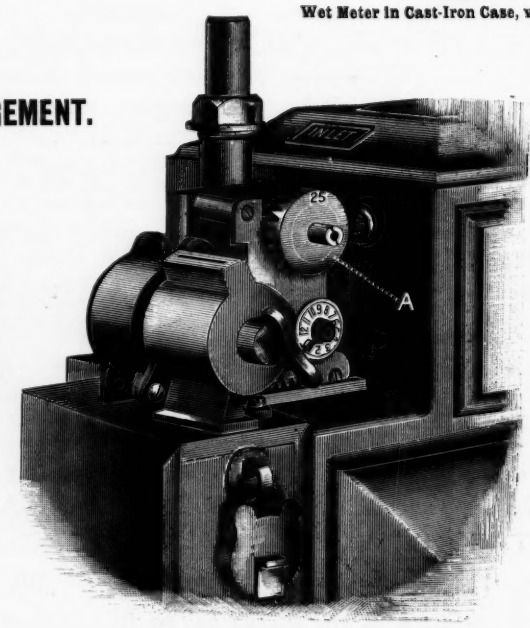
RELIABLE,

SIMPLE.



Wet Meter in Cast-Iron Case, with Attachment Removed

VIEW OF PRICE-CHANGING ARRANGEMENT.



Change of Price effected by simply removing Crown Wheel "A" and replacing same with another Wheel.

ANY FURTHER PARTICULARS WILL BE SUPPLIED UPON APPLICATION.

LATEST IMPROVEMENTS.

SULPHATE OF AMMONIA APPARATUS

SHOWING BEST RESULTS.

TAR STILLS. ACID PUMPS. AIR COMPRESSORS.

Economy in Working.

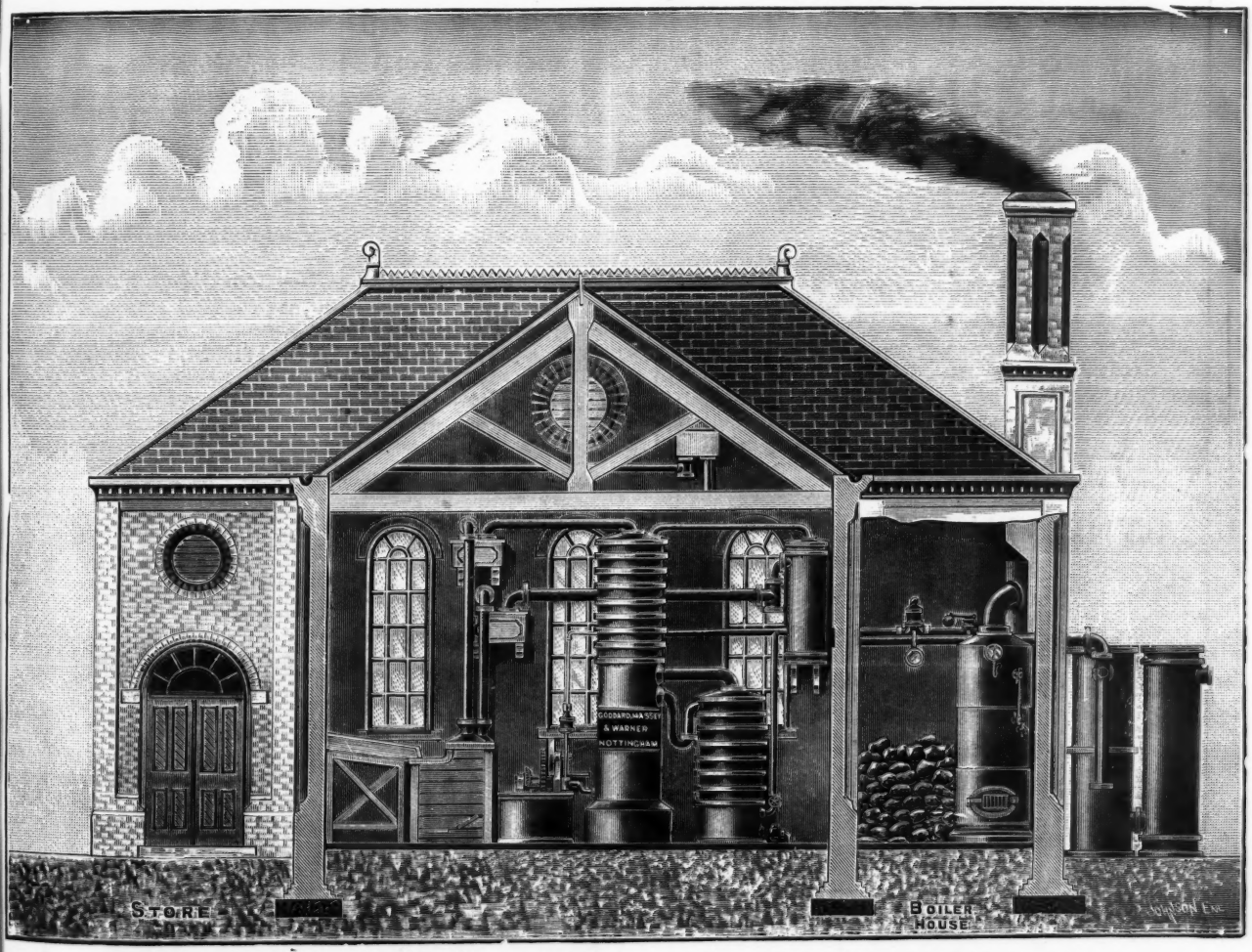
All Ammonia Recovered.

Small Quantity of Steam.

DURABLE. EFFICIENT. NO NUISANCE.

MAKERS OF ELLERY'S PATENT SATURATOR.

PUMPS, BOILERS, ROOFS, TANKS, &C.



GODDARD, MASSEY, & WARNER, LTD.,

Nottingham.

GIBBONS BROS.

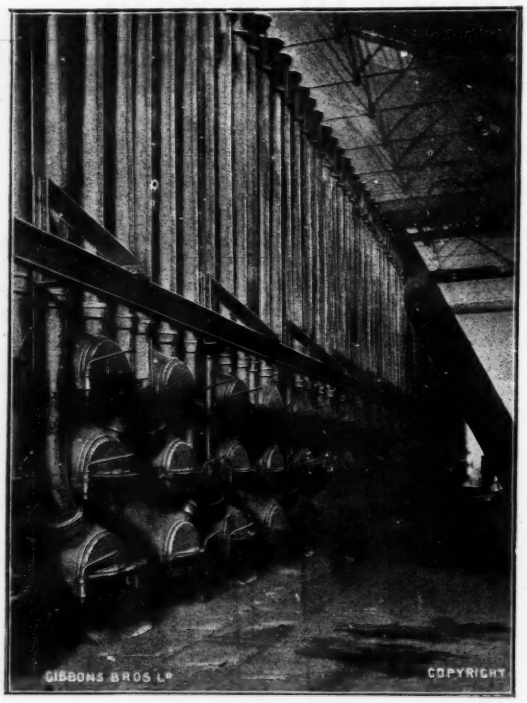
(LIMITED),

Telegraphic Address :
"GIBBONS, LOWER GORNAL."

DUDLEY,

Telephone No. **10a,**
DUDLEY EXCHANGE.

Erectors of Retort Benches, with Generator or Regenerator Settings, and Retort Bench Ironwork Complete.



Elevation showing Inclined Retort Bench with Elevator in background.

INSTALLATIONS OF INCLINED RETORTS COMPLETE.

ELEVATING AND CONVEYING PLANT.

COAL & COKE BREAKERS.

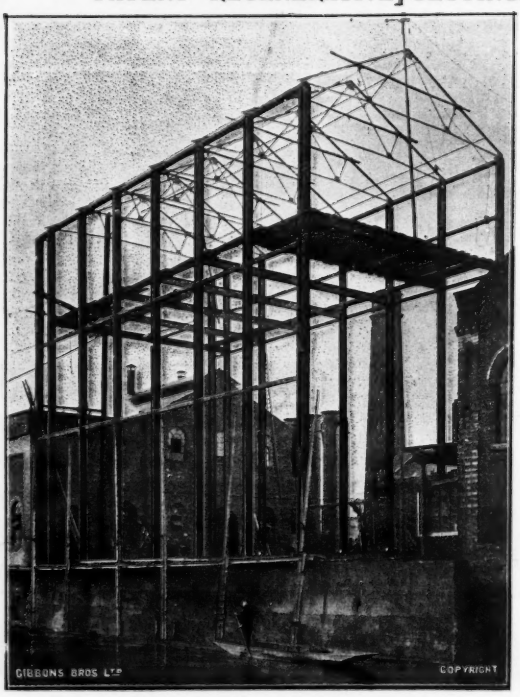
COAL & HOT COKE CONVEYORS

FITTED WITH

GIBBONS' Patent ROLLER CHAIN.

BAND CONVEYORS A SPECIALITY.

GIBBONS AND MASTERS' PATENT REGENERATIVE SETTINGS.



Steel Retort-House erected by us.

STRUCTURAL IRONWORK

OF EVERY DESCRIPTION.

Large Stock of all Gas-Works Requisites.

GIBBONS' PATENT CEMENT

FOR PATCHING RETORTS.

Manchester Office—

85, TREVELYAN BUILDINGS
52, CORPORATION STREET.

Telephone No: "128, Victoria."

London Office—
142-3, PALACE CHAMBERS,
WESTMINSTER, S.W.

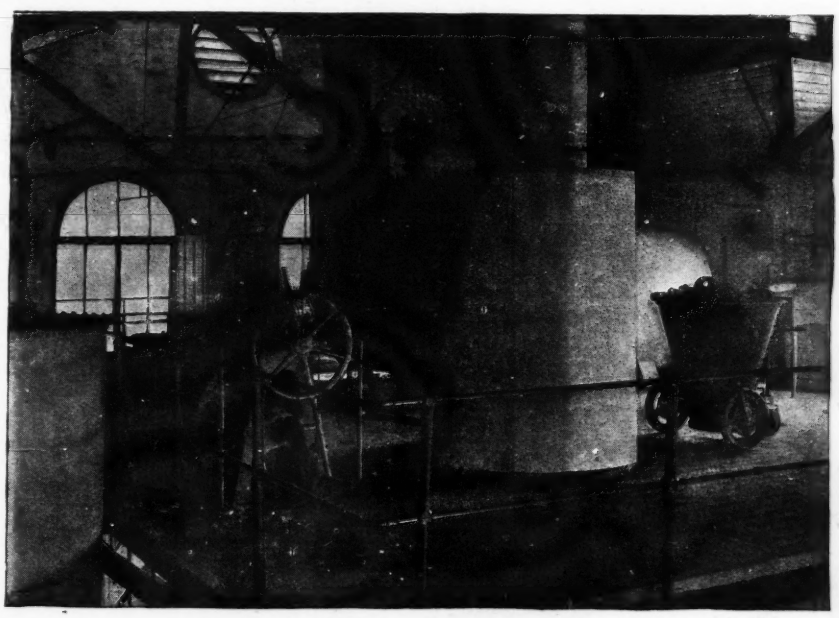
Telegraphic Address: "Giboyant, London."

WATER GAS

THE DELLWIK-FLEISCHER PROCESS.

FOR INCREASING THE CAPACITY OF COAL-GAS WORKS.

Also for Incandescent Lighting, Driving of Gas-Engines, and Manufacturing Purposes.



WEST BROMWICH.

PATENTS IN ALL COUNTRIES.

THIS PROCESS HAS BEEN ADOPTED AT THE FOLLOWING GAS-WORKS:

IN ENGLAND.—WEST BROMWICH, ILFORD, TIPTON, CLEETHORPES, BILSTON, RUSHDEN and HIGHAM FERRERS, BARKING, ILFRACOMBE.

IN THE COLONIES.—CAPE TOWN.

ON THE CONTINENT.—KÖNIGSBERG, ERFURT, ISERLOHN, REMSCHEID, PFORTZHEIM, PLAUEN (2 Orders), BARMEN-RITTERSHAUSEN, NUREMBERG (2 Orders), MÜLHEIM a/RUHR, LUDWIGSHAFEN a/RHEIN, GÜSTROW, HALBERSTADT, DORTMUND, SALZWEDEL, STUTTGART, MARIENDORF (Berlin), HANAU, FREIBERG (Saxony), FÜRTHI (Bavaria), ARNHEIM (2 Orders), BERNE, LYONS, ST. QUENTIN, ROME (2 Orders), TRIESTE, GIJON, BEYROUTH (Syria), ZUTPHEN (Holland), BRUMMEN*, OSTERFELD*, WARSTEIN*, WIBORG*.

(* Blue Water Gas with Incandescent Burners.)

Also 45 Installations for Manufacturing Purposes.

THE DELLWIK-FLEISCHER WATER GAS SYNDICATE,

25, Victoria Street, Westminster, London, S.W.

R. DEMPSTER & SONS, LTD.,

ELLAND.

Makers of

Every Description of

GAS-WORKS PLANT.

INCLINED RETORTS.

HORIZONTAL RETORTS.

GENERATOR FURNACES.

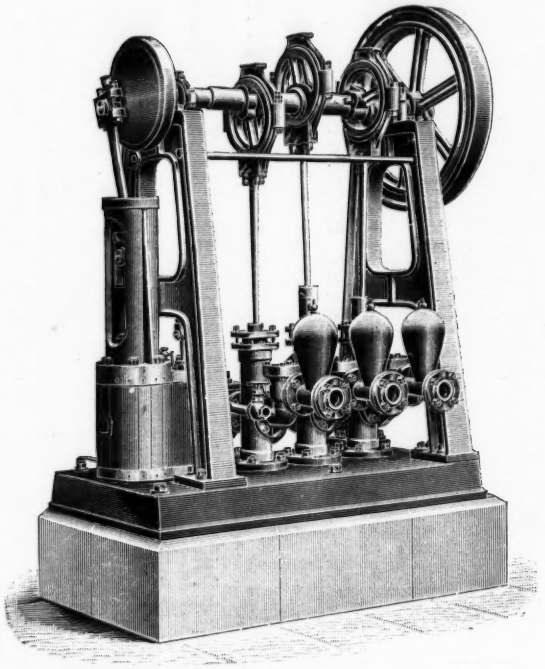
REGENERATOR FURNACES.

RETORT IRONWORK.

STRUCTURAL IRONWORK.

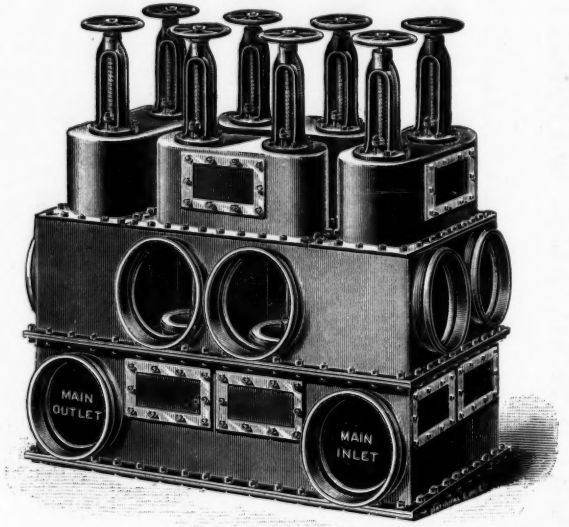
CAST-IRON WORK,

&c.



Battery of Pumps

For Tar, Liquor, and Water.



Weck's Centre-Valves.

Eight-Way, Six-Way, or Four-Way.

Makers of

GASHOLDERS.

PURIFIERS.

CONDENSERS.

SCRUBBERS.

WASHERS.

EXHAUSTERS.

PUMPS.

VALVES.

COAL ELEVATORS.

COKE ELEVATORS.

CONVEYORS.

SCREENING PLANTS,

&c.

STEWARTS AND LLOYDS,

LIMITED,

MANUFACTURERS OF

WROUGHT-IRON WELDED

TUBES AND FITTINGS

OF ALL DESCRIPTIONS FOR

GAS, STEAM, AND WATER.

LIGHT LAP-WELDED WROUGHT-IRON AND STEEL TUBES

WITH STEWART'S PATENT FLANGED JOINT AND "ALBION" LOOSE FLANGED JOINT.

HOT WATER HEATING TUBES

(PERKINS SYSTEM).

SOLID DRAWN STEEL TUBES

CAST-IRON PIPES

STEEL AND IRON PLATES FOR BOILERS, BRIDGES, &c.

OFFICES:

41, Oswald St., Glasgow,

AND

Nile St., Birmingham.

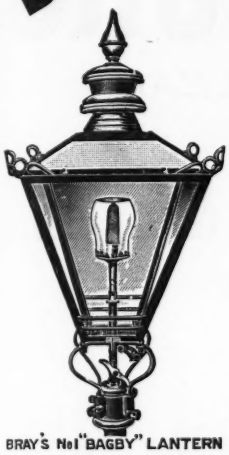
DRAKES
LIMITED
HALIFAX
FOR
COAL & COKE
ELEVATORS &
CONVEYORS.

BRAY'S INCANDESCENT LIGHTING

THE "BAGBY" LANTERNS

FOR STREET LIGHTING.

Made throughout of (Tinned) Copper.



BRAY'S No1 "BAGBY" LANTERN

ADOPTED BY THE PRINCIPAL LIGHTING COMMITTEES THROUGHOUT THE COUNTRY.

BRAY'S No.2 "BAGBY" LANTERN

POWERFUL LIGHT. RELIABLE. PRICES VERY ATTRACTIVE.

THE "BRAY" INCANDESCENT GAS-BURNER

(PATENTED AND REGISTERED).

Gives the

HIGHEST EFFICIENCY

with the

LOWEST GAS CONSUMPTION.

The BEST for Street or House Lighting.

Non-Corrosive.

Fitted with Patent Clip for Mantle Rod.

Silent in Use.

High Lighting Power.

CHEAP.

THE "BRAY" INCANDESCENT GAS-MANTLE

(LICENSED).

"XXX" QUALITY. DOUBLE WOVEN. EXTRA STRONG.

SEND FOR CATALOGUE AND PRICE LIST.

GEO. BRAY & CO., LTD., Gas Lighting Engineers, Bagby Works, **LEEDS.**

GENTLEMEN, WE STUDY YOUR REQUIREMENTS

FOR

HAND FISHING . . .
STEAM DISCHARGING
SELF-EMPTYING . . .

SATURATORS

MADE FROM ANY THICKNESS OF LEAD.

ALSO

ACID TANKS, SULPHATE DRAINERS, &c., &c.,

AND REPAIRS.

FROM A PHOTO. APRIL, 1904.

157 SATURATORS RECENTLY SUPPLIED.

J. TAYLOR & Co.

Central Plumbing Works, BOLTON.

Telegrams:—"SATURATORS, BOLTON." Telephone No. 0848.

SILICA FIRE-BRICK Co.

OUGHTIBRIDGE,

Nr. SHEFFIELD.

ESTABLISHED 1858. Trade Mark: "SILICA."

SILICA BLOCKS, BRICKS, AND CEMENT

OF SUPERIOR QUALITY FOR GAS FURNACES.

GANISTER BRICKS

SHOWING LITTLE OR NO SHRINKAGE.

"HOLDSOWN" CEMENT

FOR PATCHING RETORTS AND FURNACES TO WITHSTAND THE HIGHEST HEATS.

These goods, on account of their **GREATER DURABILITY**, are used by the largest Gas-Works in the World.

THE ANTI-VIBRATION INCANDESCENT LIGHTING CO., LTD.

We have received 17 Orders, as below.

JOWETT & SOWRY, Printers, Albion Street, Leeds.—6934.

5673 **STREET LIGHTING DEPARTMENT,**

Municipal Buildings, LEEDS, Mar. 2nd, 1904.

Mess. *A. V. I. L. Co., Leeds.*

Please Supply

500 (five hundred) single light frames as before and charge to a/c this dept.

Wm. Jackson
SUPERINTENDENT.

No Goods to be supplied without a written order, duly signed, and Invoice must accompany each delivery of Goods.

DRAUGHT PROOF LANTERN.

Specially designed for Incandescent Lighting.

All Lanterns now fitted with Patent Bottom, which removes all strain from Lantern frames.

OVER **800** IN USE IN LEEDS.

HEAD OFFICE & WORKS:
National Telephone: 116.
Telegraphic: "RESILIENT, LEEDS."

35, KIRKSTALL ROAD, LEEDS.

19, COUNTY ARCADE, LEEDS. 47, FETTER LANE, LONDON, E.C. VICTORIA ARCADE, MANCHESTER. MORLEY STREET, BRADFORD.

ALBION IRON WORKS,
MILES PLATTING,

MANCHESTER.
TELEGRAMS—
"STOKER, MANCHESTER."

WEST'S GAS IMPROVEMENT CO., LD.,

Gas and General Engineers.

CONTRACTORS FOR

COMPLETE RETORT-HOUSE PLANT

. . . EITHER ON : . .

THE HORIZONTAL OR INCLINED SYSTEMS.

Photograph showing West's Coke-Conveyor dealing with the Coke from Nineteen Through Beds of Retorts.

WEST'S IMPROVED PATENT HOT-COKE CONVEYOR,

With Special Chain constructed with a minimum number of parts, and having Large Joint Pins with ample Bearing Surfaces.

WEST'S STOKING MACHINERY— COMPRESSED AIR DRIVEN AND MANUAL SYSTEMS.

COAL BREAKING, ELEVATING, & STORING PLANTS.

BELTON'S PATENT AUTOMATIC RELIEF APPARATUS FOR HYDRAULIC MAINS.

Manufacturers for America : **Riter-Conley Manufacturing Company, Pittsburg.**

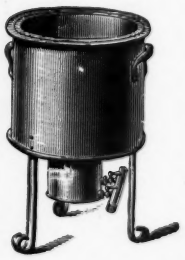
SPECIALITIES

MANUFACTURED BY THE

DAVIS GAS STOVE CO., LTD.,

LONDON, LUTON, AND FALKIRK.

HOUSEHOLD GAS COOKERS,
The famous "Diamond" and "Metropolitan" Series; "Continental" and "Colonial" Cookers for Export; Slot Cookers in great variety for small consumers; Grillers, Boiling Stoves, &c., &c.



SPECIAL LARGE APPARATUS,
Gas and Steam—for Hotels, Restaurants, Hospitals, Asylums, and Large Business Establishments.

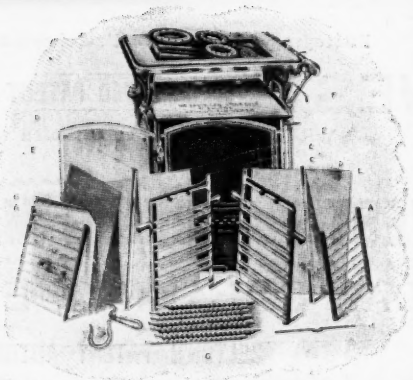
GEYSERS & CIRCULATING BOILERS,
for Baths, Greenhouses, Lavatories, and General Household Requirements.

LAUNDRY APPLIANCES.
in great variety, suitable alike for the Trade and for Domestic purposes.

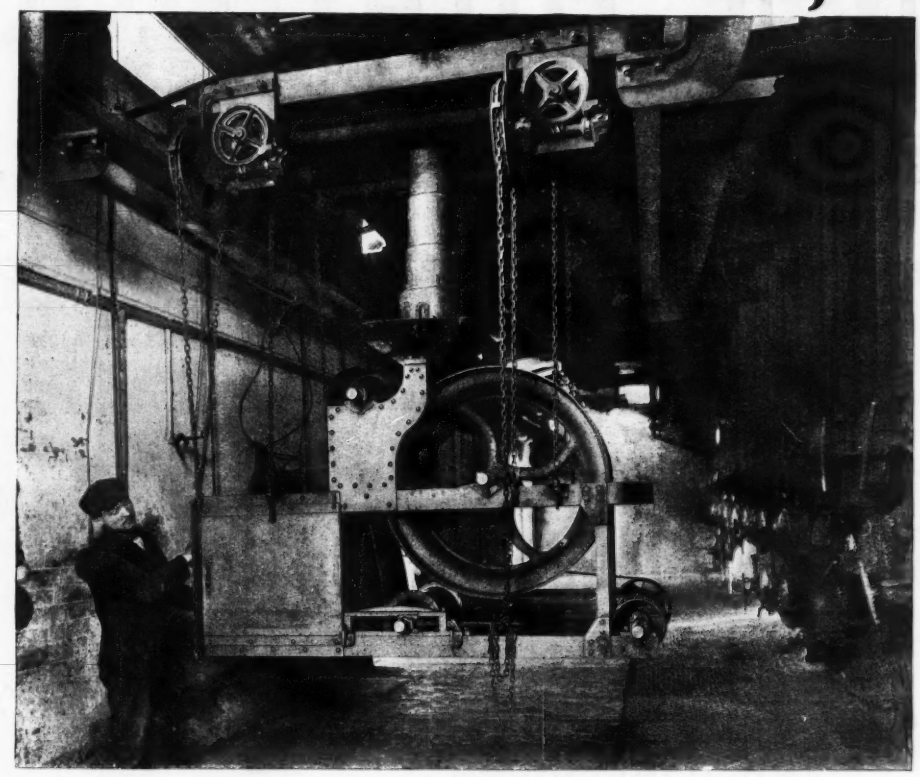
GAS HEATING STOVES
of every type, including those on the Trident Burner principle, a speciality of our own, for which there has always been a phenomenal demand.

Complete Catalogue Post Free on Application.

Head Office: 200, CAMBERWELL ROAD, LONDON, S.E.
City Show-Rooms: 59, QUEEN VICTORIA STREET, E.C.



W. J. JENKINS & CO., LTD.

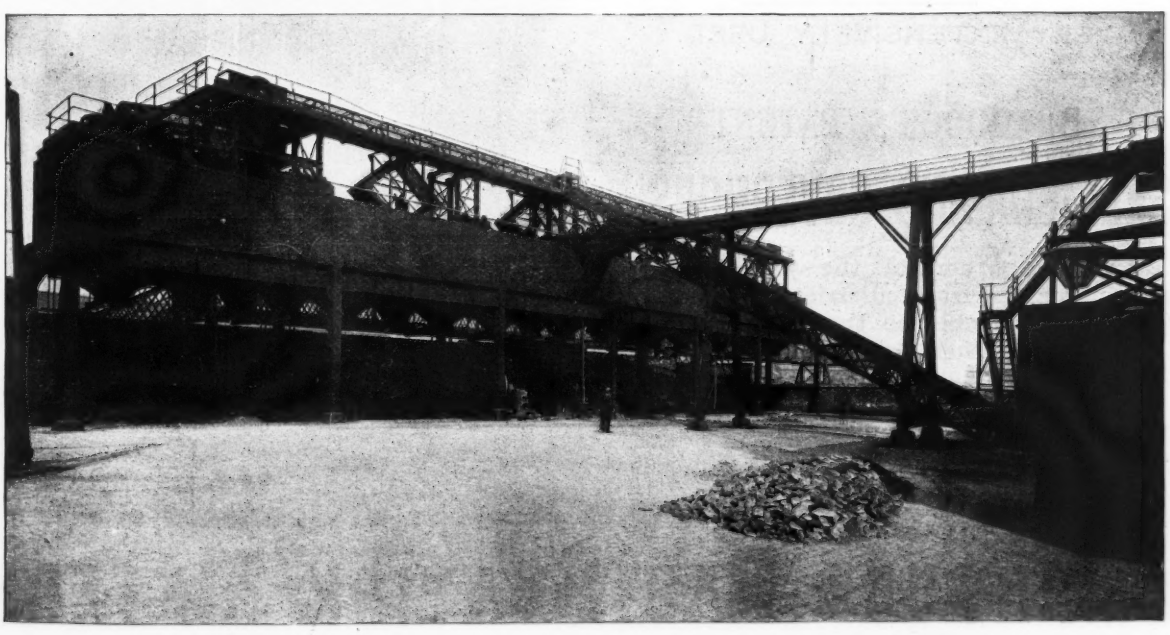


Reproduction of a Photograph of the D.B. Patent Charging-Machine as at work at the Derby Gaslight and Coke Company's Works (Cavendish Street).—J. Ferguson Bell, Esq., Engineer.

THE

DE BROUWER PATENT HOT COKE CONVEYOR

GUARANTEED BY SOLE MAKERS.



SALFORD CORPORATION GAS-WORKS—ALBION STREET WORKS.

W. J. JENKINS & Co., Limited, RETFORD.

J. & J. BRADDOCK

(BRANCH OF METERS LIMITED),

Globe Meter Works, OLDHAM.

Telegrams: "BRADDOCK, OLDHAM." National Telephone No. 254.

AND 45 & 47, WESTMINSTER BRIDGE ROAD, LONDON, S.E.

Telegrams: "METRIQUE, LONDON." Telephone No. 2412 HOP.

MANUFACTURERS OF

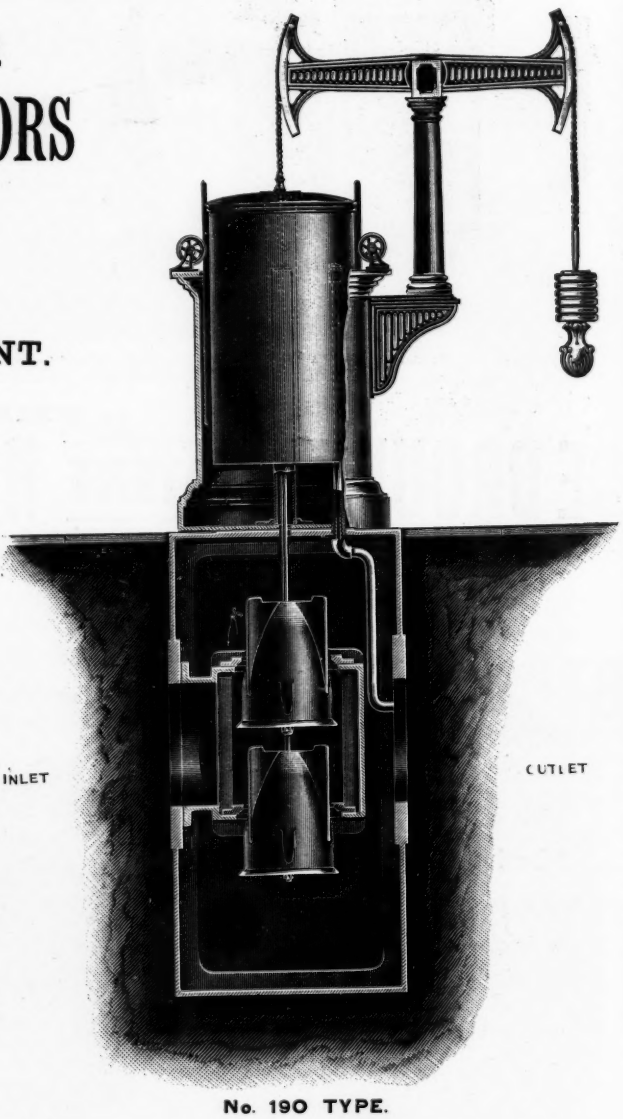
Braddock's Patent
GAS STATION GOVERNORS

The Best in the Market.

MOST COMPACT
AND CONVENIENT.

UNSURPASSED FOR
Durability,
Efficiency,
AND **Reliability.**

VERY EXTENSIVELY USED.



No. 190 TYPE.

BRADDOCK'S PATENT
SELF-LOADING GOVERNORS.

Automatically control the pressures in absolutely separate districts of supply (i.e., not connected to the outlet of any other governor).

A PROVED SUCCESS. FIRST COST SOON SAVED.

Pressures varied between fixed limits according to the demand for Gas.

IMPROVED GAS STATION METERS

(OF ALL CAPACITIES UP TO 300,000 CUBIC FEET PER HOUR.)

IN CYLINDRICAL AND RECTANGULAR CASES.

BEST QUALITY AND CONSTRUCTION. MOST SUBSTANTIALLY MADE.

THE GAS METER COMPANY, LTD.

(Late CROLL, RAIT, & CO.)

MANUFACTURERS . . OF . . EVERY DESCRIPTION OF GAS METERS & GOVERNORS, TEST HOLDERS, MAIN TAPS & LAMP TAPS.

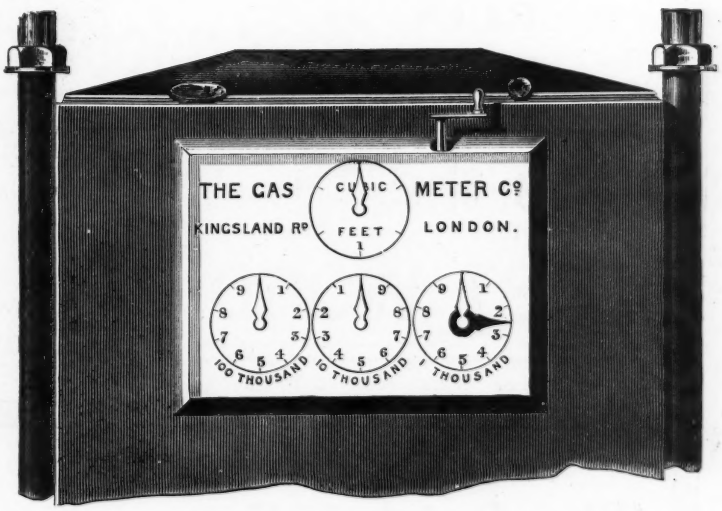
SLOT METERS.

The price of gas can be quickly changed without disconnecting meter by removing the change wheels T and B (top and bottom) and replacing with other wheels sent free of charge.

STOP METERS.

As used at CROYDON, RAMSGATE, &c.

The stop action takes effect immediately the registering pointer is in a position coincident with the black or "stop hand," which is adjusted by turning the key shown above index.



F. W. CHURCH, Secretary.
THOMAS WILKINS, Manager.

238, KINGSLAND ROAD, LONDON, N.E.
UNION STREET, OLDHAM.
7 & 8, HANOVER STREET, DUBLIN.
20, FENNEL STREET, MANCHESTER.

Telegraphic Addresses: "METER LONDON." "METER OLDHAM." "METER DUBLIN." "METER MANCHESTER."
Nat. Tel. 142, Dalton. Tel. 340, Oldham. Tel. 1995, Dublin. Tel. 2918, Manchester.

THIS TALKS!!!

We have Lighted a Section of Plymouth Docks
for the Great Western Railway Company.

An Extension has been Ordered. .

We have completed at Aylesbury an Installation—Town Hall, Market, &c. .

The Council has unanimously decided that we be requested to do the whole of the Public Lighting.

We are

50	per cent. Cheaper than	Incandescent Gas.
70	,,	Electric Arc.
80	,,	,, Incandescent.
120	,,	Ordinary Fishtail.

BERLIN, the Finest Lighted City in the World, **has adopted Millennium**

It is the **LAST WORD.**

THE MILLENNIUM SYSTEM IS A METHOD OF COMPRESSING ORDINARY GAS. . . . .

If you want to get **MORE LIGHT** and **CUT THE COST**, write—

The British Compressed Gas Co., Ld.,

57, BARBICAN, E.C.

THE GAS COAL COLLIERIES, LIMITED,

OWNERS OF

MEIROS COLLIERY,

Glamorganshire, South Wales,

Producing the BEST GAS COAL of the District,

On G.W.R. Main Line.

SHIPPING PORTS—Cardiff, Barry, Newport, Port Talbot, and Swansea. *DOCKS OFFICE—1, Stuart Street, Cardiff.*

REGISTERED OFFICES—29, St. Mary Street, CARDIFF.

Telephone No. 756 Bank. *Telegrams: "Robustness, London."*

Please Note **CHANGE OF OFFICES** from Rooms 388 to 390 Second Floor, to **ROOMS 279, 279e, 280, 281, & 282 FIRST FLOOR**

MANSION HOUSE CHAMBERS, LONDON, E.C.

INCLINES, HORIZONTAL, FLOOR LEVELS, GENERATORS,
AND REGENERATORS.

HIGH-CLASS

RETORT WORK

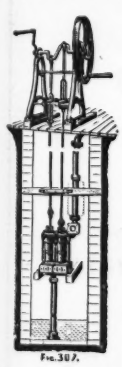
GUARANTEED.

GENERAL GAS AND WATER WORKS CONSTRUCTORS.

MAINLAYING.

Plans & Particulars—J. & H. ROBUS, Engineering Contractors, LONDON & GORING.

JOSEPH EVANS & SONS, CULWELL WORKS, WOLVERHAMPTON.



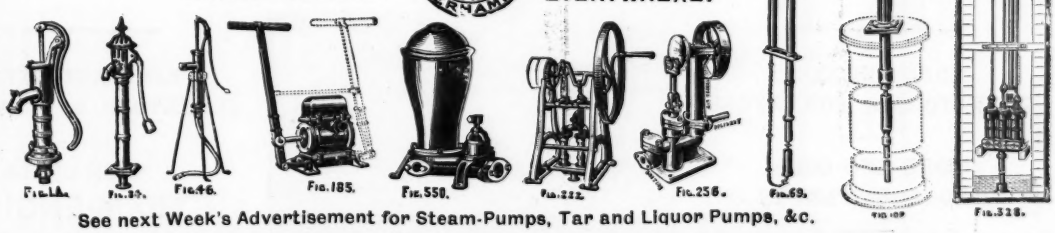
London Address:
Salisbury House, London Wall, London, E.C.

PLEASE APPLY
FOR CATALOGUE No. 8.

TRADE MARK.

FIRST AWARDS *EVERYWHERE.*

Telegrams:
"EVANS, WOLVERHAMPTON."
National Telephone No. 7039.



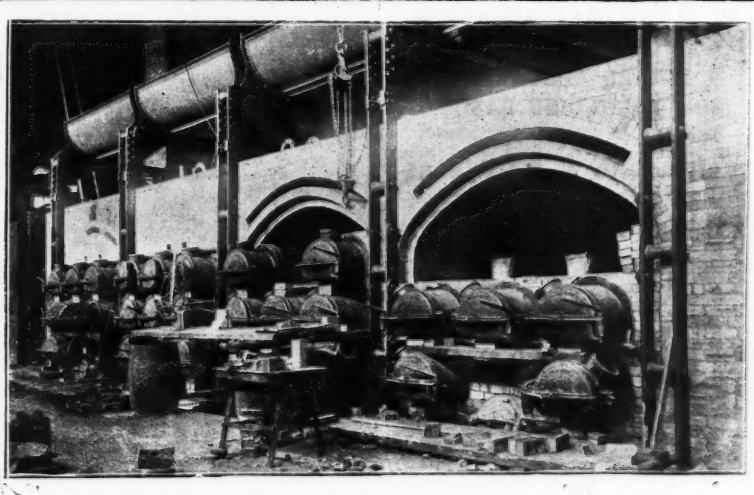
See next Week's Advertisement for Steam-Pumps, Tar and Liquor Pumps, &c.

JOHN WALSH & SONS,

CARBONIZING ENGINEERS,

HALIFAX.

INCLINED OR HORIZONTAL RETORT INSTALLATIONS.



Telegrams:
"RETORT, HALIFAX."
"EUPATHY, LONDON."

London Office:
WEST INDIA HOUSE,
96 & 98, LEADENHALL ST., E.C.

F. C. SUGDEN & Co.

OUR REGENERATOR AND GENERATOR SETTINGS

RECOMMEND THEMSELVES.

20 REPEAT ORDERS IN 2 YEARS

HAVE BEEN RECEIVED.

WE GUARANTEE

MAXIMUM MAKE PER TON AND MOUTHPIECE.

MINIMUM FUEL CONSUMPTION.

Designs & Estimates on Application.

28, EAST PARADE, **LEEDS.**

Telephone No. 3. Telegraphic Address: "ELEVATOR, HASLINGDEN."

S. S. STOTT & CO.,

ENGINEERS HASLINGDEN, NR. MANCHESTER.

COAL AND COKE ELEVATORS & CONVEYORS.

COAL AND COKE STORAGE PLANTS.

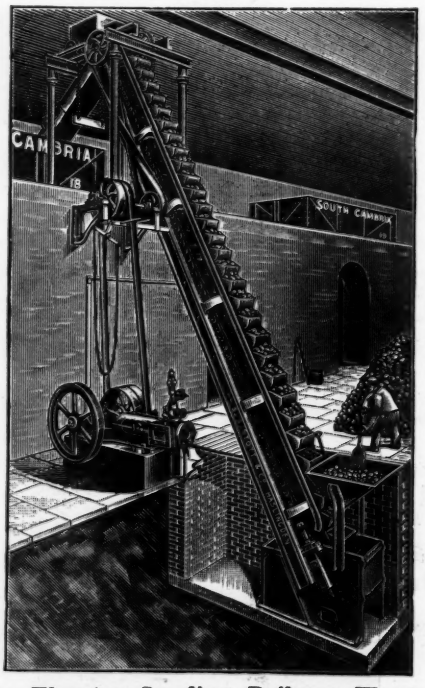
COAL AND COKE BREAKERS.

WHARF ELEVATORS FOR UNLOADING BARGES.

ELEVATORS & CONVEYORS for BOILER-HOUSES.

STAMPED AND RIVETED STEEL ELEVATOR BUCKETS.

DETACHABLE CHAINS AND SPROCKET WHEELS.



Coke Elevator Loading Railway Waggons.

LIME AND OXIDE ELEVATORS & CONVEYORS.

HIGH-CLASS STEAM-ENGINES up to 1000-Horse Power.

PUMPS, HORIZONTAL AND VERTICAL, SINGLE, DOUBLE, or THREE-THROW, for WATER-WORKS, &c.

BEAM PUMPING-ENGINES.

AIR-COMPRESSORS.

BELT PULLEYS, ROPE PULLEYS, GEARING, &c., &c.

"VERITAS"

Gas Mantles

Are acknowledged
to be unequalled for

STRENGTH,

BRILLIANCY,

AND

LONG LIFE.

Made from Ramie Fibre.
Uniform High Quality.

Our explanatory pamphlet . . .

"STRIKING FACTS ABOUT VERITAS MANTLES"

. . . posted free on request.

Prices and Samples on application to

Falk, Stadelmann, & Co.

LTD.,

"VERITAS" Lamp Works,

83, 85, & 87, Farringdon Rd., LONDON, E.C.

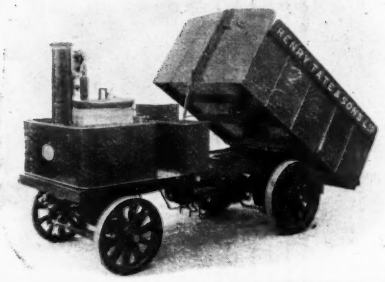
HIGHEST AWARDS WHEREVER COMPETING.

STEAM TANK WAGONS
FOR
LIQUOR
UP TO
7 TONS.

THORNYCROFT

TIP WAGONS and LORRIES of ALL KINDS for the CONVEYANCE of COAL or COKE in BAGS or BULK.

Reliability.
Simplicity.
No Chains.



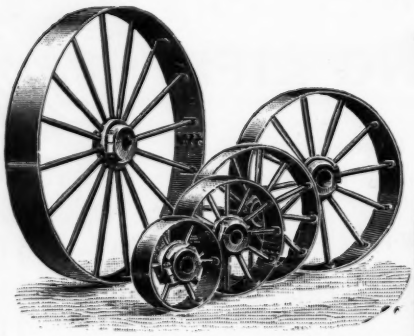
Also PETROL VANS and PLEASURE CARS.

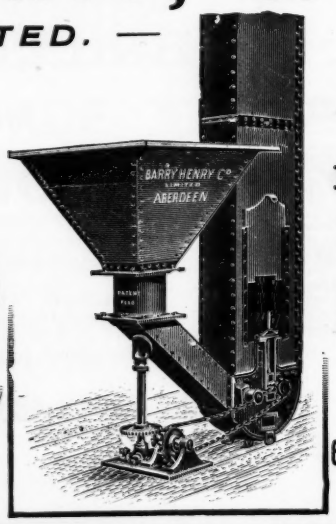
The Thornycroft Steam Wagon Co., Ltd.,
HOMEFIELD DEPÔT, CHISWICK, LONDON, W.

BARRY, HENRY, & CO.,
— LIMITED. —

Specialities:
TRANSMISSION OF POWER.
Rope & Belt Pulleys,
Spur & Bevel Wheels,
Shafting & Couplings,
Pedestals, & Fixings.

WORKS:
ABERDEEN,
SCOTLAND.





Specialities:
TRANSMISSION OF MATERIALS.
Conveyors
Elevators,
Grinding Machinery,
Motors.

AND
64, MARK LANE,
LONDON, E.C.

HUTCHINSON BROTHERS & CO., LTD.,
MAKERS OF
CONSUMERS' WET AND DRY GAS-METERS.
Brass Main Taps, Lamp Taps, Unions, Ferrules, &c., &c.
SERVICE CLEANERS. SYPHON PUMPS.
LEADWORK for SULPHATE of AMMONIA PLANT.
CHEMICAL LEAD BURNING APPARATUS. COPPER SCOOPS.
PURIFIER GRIDS. TOOLS AND SUNDRIES FOR GAS-WORKS.

FALCON WORKS, SACKVILLE STREET, BARNSLEY.
Telegrams: "HUTCHINSON BROS., BARNSLEY." Telephone 54 National.

The Francis Patent Anti-Vibrator.

The Francis Patent Anti-Vibrator is the best device on the market, and may be fitted in all Lucas Lamps.

The appearance and nature of this Anti-Vibrator will be understood from a glance at the accompanying reproduction.

SOME

Lucas Light

NOVELTIES.

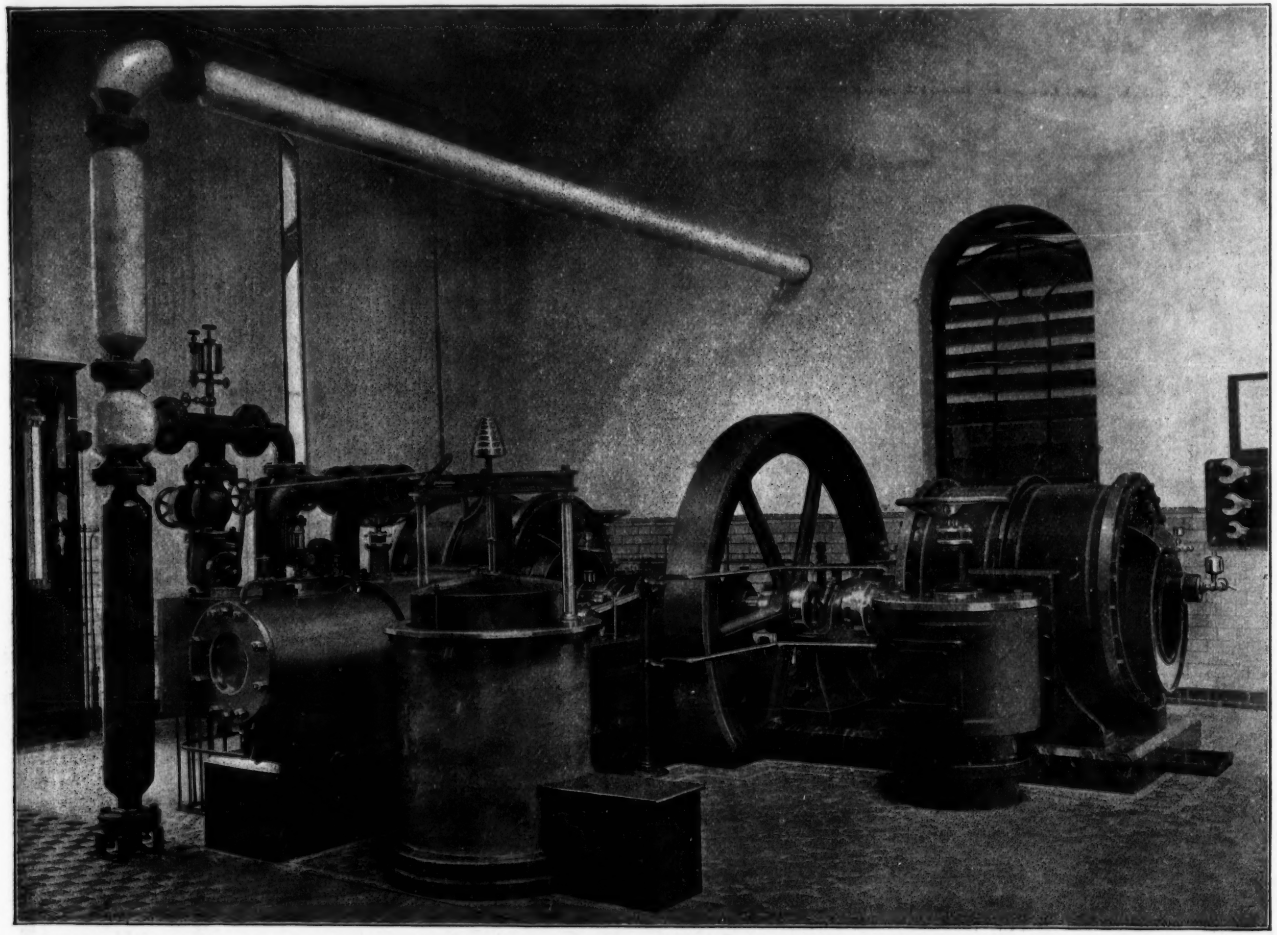
These excellent lanterns are supplied fitted with three 200, 400, or 700 c.p. burners, anti-vibrators, and an arrangement for keeping one burner alight after the two others have been turned off.

Gas Managers will find this lamp a very useful supplement to the single-burner types.

The Lucas Special Cluster Lanterns.

Moffat's Ld., 155, Farringdon Rd., London, E.C.

EXHAUSTING MACHINERY.



From a photo of Two 150,000 Exhausters and Compound Tandem Engine.

GEO. WALLER & SON,

Telegrams: "WEIGHBEAM, LONDON"; and for Stroud: "WALLER, BRIMSCOMBE."

OLDEST MAKERS.

WALLER'S PATENT

3 & 4 BLADE EXHAUSTERS

Sizes from 500 cubic feet to 500,000 cubic feet per hour.

GAS VALVES

Of all sizes and for all purposes.

PUMPS

For Tar, Liquor, and Water.

COKE BREAKERS

With or without Elevators, Screens, Conveyors, etc.

ROTARY

WASHER-SCRUBBERS

165, QUEEN VICTORIA STREET, LONDON, E.C.
Works: STROUD, GLOUCESTERSHIRE.

Telephones: LONDON, 2420 P.O. CENTRAL; and for Stroud: 210 BRIMSCOMBE.

PATENT "STANDARD" PURIFYING GRIDS.

Orders received for 148 Purifiers.

RECENT ORDERS: Ilford Gas Company, Barnet District Gas and Water Company, and Wadhurst and Ticehurst District Gas Company.

CAPACITY OF PURIFIERS MORE LARGELY INCREASED.

Pressure and Cost of Emptying and Filling more Largely Reduced than by any other System.

Figures from Users verifying this on application to—

KIRKHAM, HULETT, & CHANDLER, LTD. PALACE CHAMBERS, BRIDGE ST., WESTMINSTER, S.W.

THOS. CASH, SON & Co.,

Gas Coal and Cannel Proprietors,

WARWICK CHAMBERS, CORPORATION ST.,

Telephone No. 4610.
Telegraphic Address—
"CASHED, BIRMINGHAM."

BIRMINGHAM.

MOBBERLEY & PERRY,

STOURBRIDGE.

INCLINED RETORTS A SPECIALITY.

HORIZONTAL AND SEGMENTAL RETORTS.

BEST QUALITY OF FIRE-CLAY GOODS.

Specials for Water-Gas Plants. Chequer Bricks always in Stock.

Telephones: LONDON, 2420 P.O. CENTRAL; and for Stroud: 210 BRIMSCOMBE.
Telegrams: "WEIGHBEAM, LONDON"; and for Stroud: "WALLER, BRIMSCOMBE."

KIRKHAM, HULETT, & CHANDLER, LTD.,

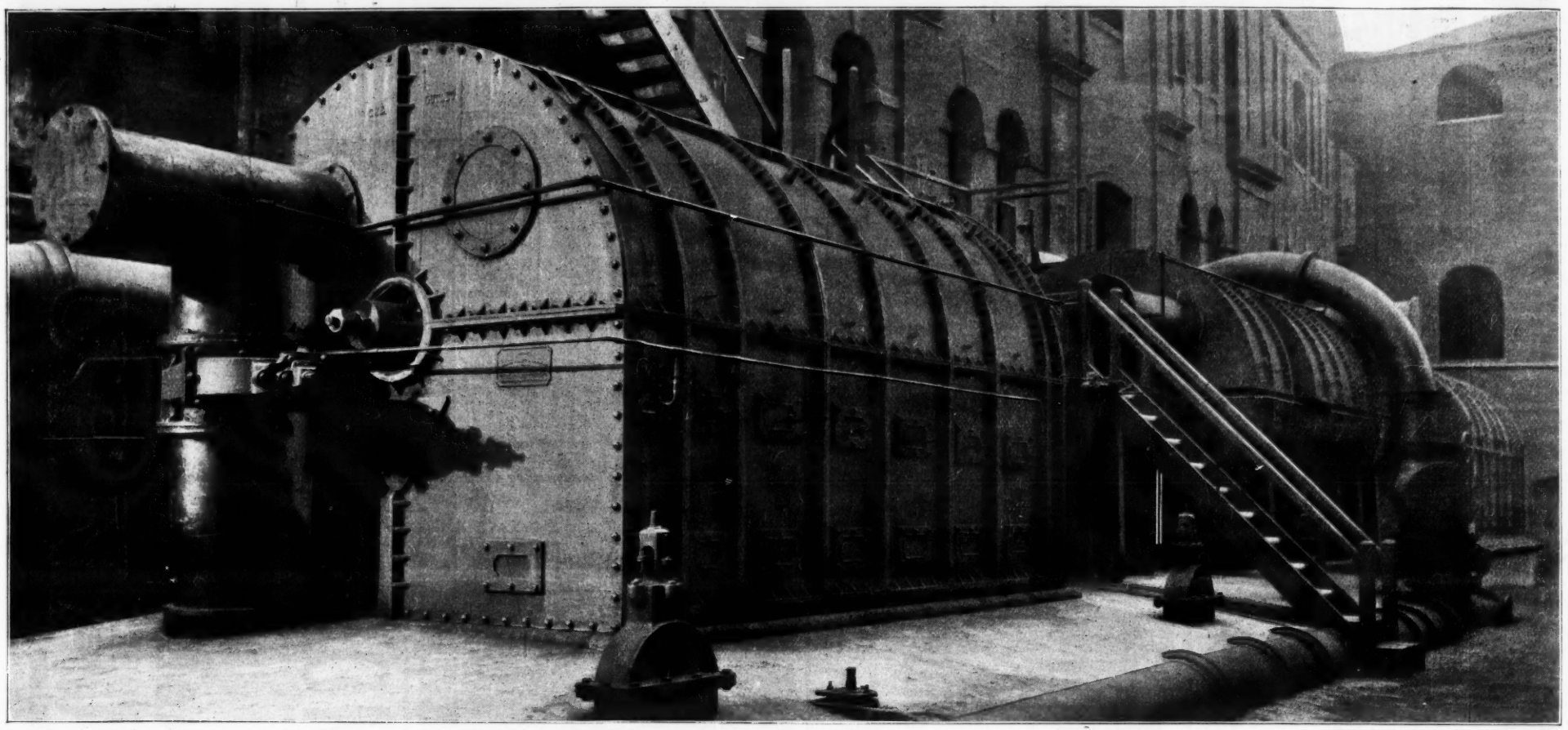
Palace Chambers, Bridge St.,
Westminster, S.W.

Tel. Ad.: "WASHER, LONDON."
T.N.: 127 VICTORIA.

(1883) PATENT "STANDARD" WASHER-SCRUBBERS. (1903)

Erected at THE PORTSEA ISLAND GAS CO.'S WORKS.

NOTE.—The 1903 Machine shown at Centre is divided into Sections, with Intermediate Isolated Bearing Chambers.

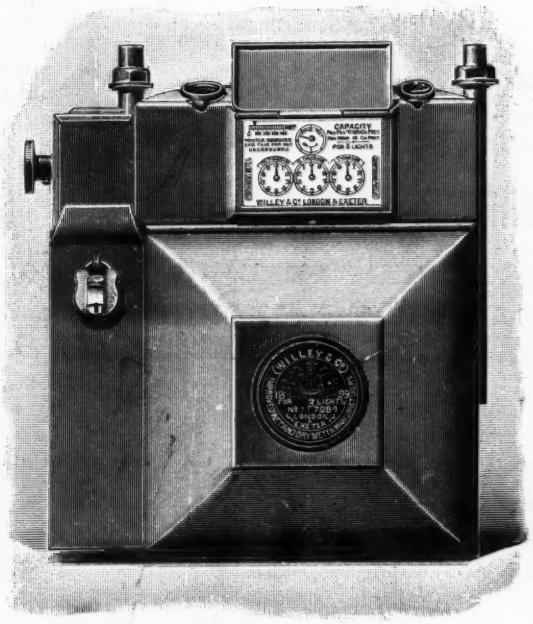


Extract from letter from Engineer, referring to Machine erected in 1903:—**"I cannot speak too highly of your Machine, and the same is giving me EVERY SATISFACTION."**

QUALITY!

QUALITY!!

QUALITY!!!



Quality is our best Salesman.

WILLEY & CO., LTD., LONDON & EXETER.

We are Sole Agents for the Patent Self-Acting Governors for the

NEW INVERTED BURNERS.

Descension.
For use above Burner.

By using these Governors the breakage of Mantles and Globes and carbonizing of China Cone is reduced to a minimum.

Adjusted for No. 1 Burner to Pass 3½ cubic feet per hour.
Adjusted for Bijou Burner to pass 1¼ cubic feet per hour.
Screwed for 3/8th Brass M. & F.

Ascension.
For use under Adapter.

GLASMI MANTLES

are MADE OF THE BEST RAMIE THREAD.

USE "GLASMI" MANTLES.
THEY HAVE NO EQUAL.

are MOST BRILLIANT, STRONGEST, AND LAST LONGEST.

GLASMI MANTLES

USED BY THE LEADING GAS CO.'S AND CORPORATIONS THROUGHOUT THE KINGDOM.

THE . . .

"SICLOPS"

Self Intensive

GAS LAMPS.

Many Important Improvements are introduced in our new 400 c.p. Lamp. By its Patent Regulating nipple the supply of Gas can be adjusted to a nicety, thus ensuring the best possible results with the least consumption of Gas.

Write for Lists and Prices.

700 c.p.
No. 7112
FOR INSIDE

THE . . .

"SICLOPS"

Self Intensive

GAS LAMPS.

Develop as much light as an electric arc at less than one-third the cost. They give a most brilliant, steady, and penetrating light. They are noiseless, and their combustion is perfect.

MADE FOR BOTH INSIDE & OUTSIDE LIGHTING.

400 c.p.
No. 7365. *Write for Lists and Prices.*
LIGHTING.

J. & W. B. SMITH,

19 to 23, FARRINGDON ROAD, LONDON, E.C.

NOW

is the Time to push the Sale of Gas Cookers.

The 'ACME' Cooker is unsurpassed for Hiring purposes.

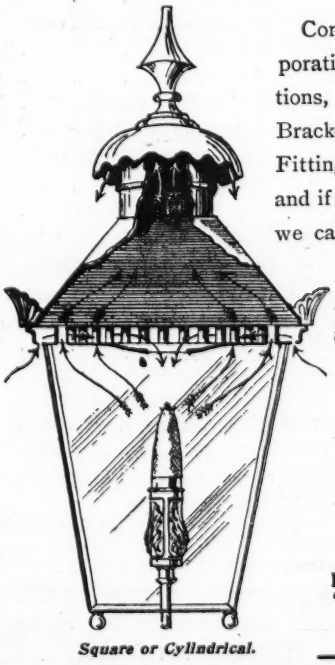
ARDEN HILL & Co.,
"ACME" WORKS,
BIRMINGHAM.

POND & CO. AND THE BRITISH ARMY

ARE INSTITUTIONS.

BOTH GO ANYWHERE AND DO ANYTHING, WELL.

The "GALE-PROOF" LANTERN.



Square or Cylindrical.

Fixed round the Coast. A Proved Success.

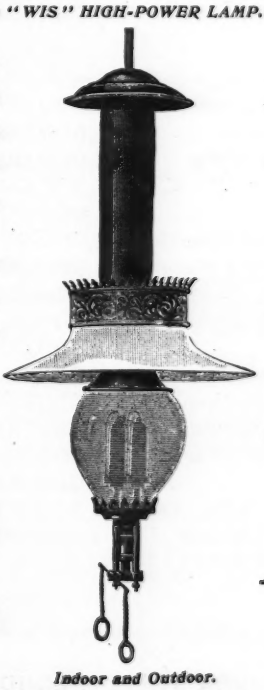
Contractors for Public Works, Corporations, Railways, Automatic Installations, Street Lanterns, Slot Pendants, Brackets, Steel Wire Brushes, Brass Fittings, &c. (anything and everything), and if you are troubled with the "wind" we can comfort you, as we have in our "Gale-Proof" Lantern (which is regenerating and self-intensifying, dust and insect proof) a

CURE FOR ALL "WIND" TROUBLES.

(DR. POND'S REMEDY.)

Patentees and Manufacturers of the "POND" Patent Arc Lamp, "WIS" Shade Light, &c.

The "WIS" HIGH-POWER LAMP.



Indoor and Outdoor.

The World's Verdict: A "Perfect" Lamp.

62, FARRINGDON STREET, LONDON, E.C.

Messrs. HUMPHREYS & GLASGOW

CARBURETTED-WATER-GAS PLANT

DOUBLE-SUPERHEATER SYSTEM.

	Cubic Feet Daily.		Cubic Feet Daily.		Cubic Feet Daily.
Copenhagen	700,000	Holyoke, Mass	600,000	Maidenhead	225,000
Copenhagen (Second)	2,500,000	St. Joseph, Mo.	750,000	Epsom	225,000
Belfast	1,700,000	Lea Bridge	350,000	North Middlesex	150,000
Belfast (Second)	4,500,000	Lea Bridge (Second)	350,000	Wandsworth & Putney	1,800,000
Brussels—Ville	750,000	Stockton-on-Tees	500,000	Aarhus	800,000
Brussels—Ville (Second)	750,000	Edinburgh	2,000,000	Falmouth	150,000
Liverpool	3,500,000	Guildford	350,000	Southampton	800,000
Liverpool (Second)	4,500,000	Brentford	1,200,000	Hartlepool	750,000
Tottenham	750,000	Syracuse, N.Y.	850,000	Utrecht	1,000,000
Tottenham (Second)	750,000	Bridlington	150,000	Deventer	150,000
Santiago de Cuba.	400,000	Middlesbrough	1,250,000	Portsmouth	1,000,000
Swansea	750,000	Croydon.	1,250,000	Bournemouth	1,000,000
Manchester	3,500,000	L. & N.W. Rly., Crewe	700,000	Aylesbury	150,000
Brighton	1,750,000	Taunton.	225,000	Hamburg	1,750,000
Preston	1,400,000	Lawrence, Mass.	400,000	Redhill	275,000
New York	1,200,000	Commercial Gas Co.	850,000	Dublin	2,000,000
Southport	750,000	Commercial (Second)	850,000	Posen	450,000
Bath	1,000,000	Commercial (Third)	1,250,000	Dunedin, N.Z.	150,000
Newburgh, N.Y.	350,000	Rotterdam	850,000	Lincoln	500,000
Newburgh (Second)	250,000	Dorking.	150,000	Brighton (Second)	1,850,000
Hoylake.	125,000	McKeesport, Pa.	500,000	Stockport (Second)	600,000
Coventry	600,000	G. L. & C. Co., Bromley	3,750,000	Croydon (Second).	625,000
Coventry (Second)	600,000	G. L. & C. Co., Nine Elms	2,750,000	Maidenhead (Second)	225,000
Bordentown, N.J.	125,000	Durham.	200,000	G. L. & C. Co., Beckton	2,250,000
Winchester	225,000	New York	4,000,000	G. L. & C. Co., Fulham	1,750,000
Shanghai	225,000	Scarborough.	800,000	Watford.	300,000
Stockport	600,000	Perth, W.A.	125,000	Eastbourne	1,250,000
Norwich	1,000,000	Bremen.	550,000		

Since Jan. 1st 1900.

Antwerp	1,500,000	Waltham	400,000	Sydney–Harbour (Second)	500,000
Brussels—Forest	1,000,000	Geneva	500,000	Sydney–Mortlake (Second)	500,000
Tottenham (Third)	350,000	The Hague	1,000,000	Watford (Second).	350,000
Sydney (Harbour)	500,000	Romford.	300,000	Southport (Second)	900,000
Sydney (Mortlake)	500,000	Göteborg	300,000	**FOR THIS YEAR'S CONSTRUCTION.**	
Manchester (Second)	3,500,000	Carlisle	600,000	Dunedin (Second).	275,000
Longton	600,000	Redhill (Second)	300,000	Taunton (Second).	350,000
Hull	1,500,000	Heidelberg	200,000	Bognor	100,000
St. Gallen	225,000	Rotterdam (Second)	1,500,000	Bournemouth (Second)	500,000
Colney Hatch	400,000	North Middlesex (Second)	200,000	Vienna	3,500,000
Dublin (Second)	2,000,000	Rotterdam (Third)	750,000	Maastricht	200,000
Birmingham.	1,500,000	Merthyr Tydfil	300,000	Antwerp (Second).	1,000,000
Tunbridge Wells	1,000,000	Shanghai (Second)	225,000	Tottenham (Fifth)	1,000,000
Faversham	200,000	Magdeburg	1,400,000	The Hague (Second)	500,000
Staines	600,000	Posen (Second)	700,000	Hampton Court	500,000
Commercial (Fourth)	2,000,000	Barrow	300,000	Lea Bridge (Third)	400,000
Southampton (Second)	500,000	Reichenberg	200,000	Dublin (Third)	650,000
Liége	1,000,000	West Ham	1,500,000	North Middlesex (Third)	75,000
Hebden Bridge	200,000	Deventer (Second)	200,000	St. Gallen (Second)	225,000
Chorley	300,000	Bremen (Second)	950,000	St. Josse, Brussels	1,000,000
Stafford	500,000	Malta	400,000	Dundee	1,500,000
Bridlington (Second)	200,000	Croydon (Third)	625,000	Bridgwater	200,000
Beckton (Second).	10,750,000	Tilburg	400,000	West Ham (Second)	800,000
Tottenham (Fourth)	1,000,000	Ostend	100,000	Brieg, Silesia.	100,000
Gosport.	200,000	Zwolle	200,000	Brussels–Ville (Fourth)	350,000
Brussels—Ville (Third)	1,500,000	Utrecht (Second)	1,000,000	Innsbruck, Austria	200,000
Swansea (Second)	1,000,000	Port Elizabeth	400,000	Marlborough	100,000

H. & G. TOTAL OF ABOVE CAPACITIES **150,200,000** CUBIC FEET DAILY.
UNITED GAS IMPROVEMENT CO., U.S.A. **423,600,000** CUBIC FEET DAILY.

TOTAL 573,800,000 CUBIC FEET DAILY.

38, VICTORIA STREET, LONDON, S.W.
Telegrams: "EPISTOLARY LONDON.

UNITED STATES OFFICE:
31, NASSAU STREET, NEW YORK.

CONTENTS.

EDITORIAL NOTES.

GAS, &c.—

The Meeting of the Gas Institution . . . 723
The Report of the Departmental Committee on the Testing of London Gas. . . . 723
Proposed Reorganization of the Board of Trade and the Local Government Board 724
Oxygen in Incandescent Lighting—Some Experiences—The Astonishment of the "Daily News"—Some Results—And Admissions—Municipal Savings Banks—And Insurance 724

WATER AFFAIRS—

Water Engineers in Conference at Hull . 726

INSTITUTION OF GAS ENGINEERS.

ANNUAL MEETING IN LONDON—

Review of Proceedings 731
A Sketch of the Proceedings 733
Social Events of the Week 740
General Report—
Confirmation of Minutes; Report and Accounts 741
President's Address; The Lecture and Papers; The Benevolent Fund . . . 742
Officers and New Members: Votes of Thanks 743
The Lecture—Professor Harold B. Dixon, M.A., F.R.S., on "The Mechanism of Combustion". 745
Papers and Discussions—
Ten Years' Experience with the Prepayment Meter. By Alfred Colson, of Leicester 753
Experiences at Middlesbrough with Gasholder Tanks on Marsh Land. By David Terrace, of Middlesbrough . . 758
Condensation of Illuminating Gas. By Dr. Harold G. Colman, of London. . 760
De Brouwer Stoking Machinery at Derby. By J. Ferguson Bell, of Derby . . . 766
Membership Additions and Transferences. 778

ESSAYS AND REVIEWS.

The Report of the Departmental Committee on London Gas 728
The Earl's Court Gas Exhibition 730
Gas and Water Stock Market 781
Sulphate of Ammonia as Manure 781
Electric Lighting Memoranda 781
A New Edition of "Ryde on Rating" . . 782
The Analytical Valuation of Gas Coals . . 782

TECHNICAL RECORD.

British Association of Water-Works Engineers—Annual Meeting at Hull—
General Business 778
Inaugural Address of Mr. F. J. Bancroft, B.Sc. 778

CORRESPONDENCE.

The Conversion of Coke Dust and Breeze into Large Coke 784
Looking Back 784
The Houghton-le-Spring Gas-Works in the Past 784
Comparative Cost of Gas and Electricity. . 784
The Law of Bankrupts' Gas Accounts . . 784

PARLIAMENTARY INTELLIGENCE.

Progress of Bills 785
Gleanings from the Committee Rooms . . 785
The Sheppey Gas Bill 785
Court of Referees—Local Government Board Provisional Order (No. 11) Bill 786
Police and Sanitary Committee—Swindon Corporation Bill. 787

LEGAL INTELLIGENCE.

High Court of Justice—Chancery Division—The Hessle Gaslight and Coke Company, Limited, and Electric Lighting 788
Bow County Court—Clark *v.* The Gaslight and Coke Company. 789

MISCELLANEOUS NEWS.

Examinations in Gas Manufacture—The Pass List 789
Coventry Corporation Gas Supply 789
A Satisfactory Year at Bury 790
Price of Gas for Power at Burton 790
Lincoln Gas and Water Supply—Cheaper Gas 791
Incandescent Gas Lighting for Southwark . 791
The Price of Illuminants in German Towns . 791
Sale of Stocks and Shares 792
Electricity Supply at Bolton 792
Metropolitan Water Board 792
Grand Junction Water-Works Company . . 792
Sheffield Corporation Water Supply . . . 793
The New Reservoir for New York 794
Stock and Share List 794
Notes from Scotland 795
Current Sales of Gas Products 796
Coal Trade Reports 797

PARAGRAPHS.

The Award in the Hucknall Huthwaite Gas Arbitration 727
Personal. 782
American Gas Engineers at the St. Louis Exhibtion 783
Incandescent Gas Lighting in Lambeth . . 797
Bangor Gas and Water Supply—The King and Queen to Open the Birmingham Welsh Water-Works—Alleged Further Pollution by the Crystal Palace District Gas Company—Gas Consumption at Teignmouth—Devonport Gas Undertaking—Gas Preferred to Electricity at Lisburn 798
Alexandria Water Company, Limited—Increased Storage at Darlington—Increase in Price at Middleton—Gas and Water Profits at Carlisle—Increased Consumption at Loughborough—Proposed Reduction of Price at Bradford—Fleetwood Water Supply—Electric Lighting in Marylebone—The Bishop's Stortford District Council and the Gas-Works 799
Water Scheme for Ampleforth—Quality of the Water Supply at Saddleworth — Injury Caused by a Projecting Water-Pipe—Southport Gas Supply. 800

HENRY BALFOUR & CO.

LIMITED,

LEVEN, FIFESHIRE.

Contractors for the Supply and Erection of all Classes of

Gas-Works Plant.

THE "ANNULAR" BRUSH WASHER-SCRUBBER

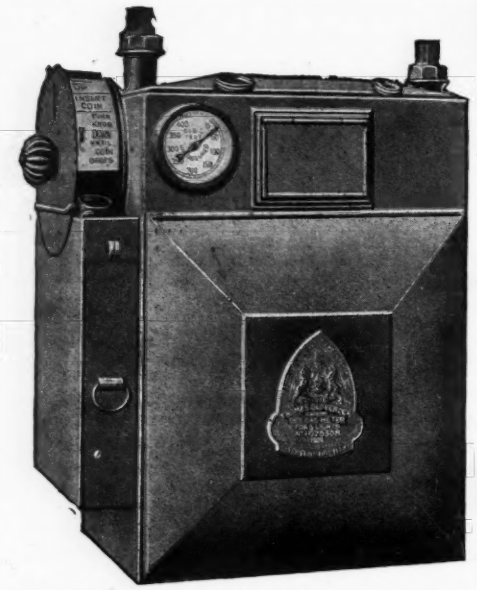
(CREEKE'S PATENT).

Made with Cast-Iron or Mild Steel Cylinders.

PRICES AND PARTICULARS ON APPLICATION.

London Representative: MR. HENRY PUPLETT, 47, VICTORIA STREET, S.W.

THOMAS GLOVER & CO.'S



PATENT NEW IMPROVED PREPAYMENT METER

For Pennies, Shillings, or any Coin.

Simple in Mechanism.
Positive in Results.
Price Changer *in Situ.*

GUARANTEED FOR FIVE YEARS.

Telegraphic Address: "GOTHIC, LONDON." Telephone No. 6159 Bank.

THOMAS GLOVER & CO., LTD.,

GAS-METER MANUFACTURERS,

LATE OF CLERKENWELL, NOW 49, QUEEN VICTORIA STREET.

Telegraphic Address: "GOTHIC, LONDON." Telephone No. 6159 Bank.

BRISTOL:	BIRMINGHAM:	MANCHESTER:	GLASGOW:	BELFAST:	MELBOURNE:
28, BATH STREET. *Telegraphic Address:* "GOTHIC." Telephone No. 1005.	57 & 58, BROAD STREET. *Telegraphic Address:* "GOTHIC"	132 & 134, CORN EXCHANGE BUILDINGS. *Telegraphic Address:* "GOTHIC." Telephone No. 3898.	26, WEST NILE STREET. *Telegraphic Address:* "GASMAIN." Telephone No. 6107 Royal.	8, EXCHANGE PLACE, DONEGALL STREET. *Telegraphic Address:* "GOTHIC."	23, WRIGHT'S LANE, LONSDALE STREET. Telephone No. 3716.

PARKINSON'S

PREPAYMENT METERS

For Pence, Shillings, or any Coin.

SIMPLICITY . }
DURABILITY . . } COMBINED.
EFFECTIVENESS }

PARKINSON AND W. & B. COWAN, LTD.
(*Parkinson Branch*),

COTTAGE LANE, CITY ROAD, LONDON. | BELL BARN ROAD, BIRMINGHAM.

JOURNAL OF GAS LIGHTING, WATER SUPPLY, &c.

EDITOR & PUBLISHER: WALTER KING. OFFICE: 11, BOLT COURT, FLEET ST., LONDON.

VOL. LXXXVI., No. 2144.—TUESDAY, JUNE 14, 1904.

EDITORIAL NOTES—GAS, &c.

The Meeting of the Gas Institution.

IT is extremely gratifying to be able to record the fact that the meeting last week of the Institution of Gas Engineers was successful in a degree surpassing even the favourable expectation that was formed respecting the prospects of the gathering. It is safe to say that the large attendances throughout, including the afternoon sitting on Thursday necessitated in order to clear off the programme, were without precedent. Much of the success was due to the personal influence of the President, Mr. H. E. Jones, whose geniality and unaffected pleasure in discharging the duties of the Chair were greatly appreciated. Both in his address and otherwise, the President furnished ample proofs of his possession of that quality of sympathy which is probably the most precious attribute of a really good Chairman. The papers were, without exception, worthy of the writers and the occasion; and the discussions were adequate. As to the lecture, by Professor Harold B. Dixon, there were no two opinions concerning its merit. The only regret in relation to it is that it is practically impossible to present in print and in illustration the real charm of the lecturer's style, and the indescribable beauty of his lantern pictures. This observation, however, only goes to show that those who desire to reap the fullest benefit from such meetings should attend them personally whenever possible. The net result of all this success, as was remarked by the President-Elect, Mr. D. Irving, of Bristol, is to strengthen the feeling that the time has now arrived for the Institution to enter upon its inheritance, and occupy the extended sphere of usefulness which all its members are willing to believe is now open to it. Constitutional weaknesses are of the past. For the future there can be no looking back, but only pressing forward.

The success which has so far rewarded the efforts of those who have laboured for the unity of the personality of the British gas engineering profession, will encourage them and others to persevere until the long-desired object is completely attained. Meanwhile, it would probably be a mistake to attempt to hurry matters on; and the end will be reached all the sooner by a deliberate, almost unconscious, approach. Those are wise who wait for the sense of the passing of the day of sectional and independent organizations to sink into the minds of those whom it may concern. The growing uniformity of the needs and conduct of the gas industry will help to bring its leaders together. As the President remarked in his address, the ancient differences between the large and the small gas-works tend to disappear, if they are not already gone. Nowadays, the most experienced consulting engineer can learn from the works manager things which it imports all to know; and the Institution should be the agency for the greater diffusion of the better and more exact knowledge which an ever-increasing band of observers is gathering in greater volume yearly.

There are many purposes which the united Institution can subserve; but it is not particularly opportune to enlarge upon this order of subjects just now, on the morrow of the interesting and memorable occasion when the organization began its new life. The members whose memory goes back over many meetings will perhaps be those who will be most hopeful for the future. Now, for the first time, the gas engineers of the United Kingdom can feel that they have a corporate life of their own, and a place in the numerous galaxy of specialized institutions that have grown up in recent years round the venerable foundation in Great George Street, which is really their mother. One can scarcely help wondering, when thinking of this numerous family of engineering societies, all alive and growing—some even with scions of their own beyond the seas—what new-comers there may still be within the circle. Will there arise yet other branches of engineering, to serve humanity in ways as yet unknown? None can say; but it is at least certain that the fashion of these societies will always remain such as that to which the Institution of Gas Engineers has at length attained, and that mutual goodwill and helpfulness among the scattered followers of a common calling will never fall out of date. Arts are long, and alter; and the life of man is short. To fit the one more perfectly to the other is the real purpose of these organizations; and there is no calling which needs this help more than that of the gas engineer. It is something to be thankful for that at last the profession is suited with an outward and visible bond of unity, which should increase in strength with the course of the years.

The Report of the Departmental Committee on the Testing of London Gas.

IN another column will be found the report of the Board of Trade Departmental Committee on the Testing of London Gas, as to which imperfect statements obtained circulation in the course of last week, and even got into the transactions of the Institution of Gas Engineers. It will be wise to drop all other dealings with the matter, and concentrate attention upon the actual report of the Committee now before the readers of the "JOURNAL," for an early copy of which we have to thank Mr. H. C. Honey, the Secretary of the Committee, who recognized in this way the legitimate claim of the gas industry to timely intelligence as to the result of this most important inquiry. The gist of the Committee's recommendations, which were unanimous, is substantially as brought by Sir George Livesey under the notice of the members of the Institution present at the meeting on Thursday afternoon, which met with a strongly unfavourable reception. Without going into any discussion on that proceeding, it is only candid for us to remark here that the full report and recommendations will be read by gas engineers with mingled feelings. Regarded as a pronouncement that has necessarily—though, of course, not officially—a general application to the conditions of gas supply throughout the United Kingdom, this document will give the profoundest disappointment, such as must follow the perception that a great opportunity has been lost. Appointed at a time when the gas industry of the United Kingdom had awakened to a sense of change in the character of the public service which it exists to perform—the change, naturally, being felt first and most keenly by the three Metropolitan Gas Companies—it was generally expected that the Departmental Committee would interpret the terms of the reference in a broad-minded way, and rise to the occasion. There were hopes that their investigation into the law, science, and common sense of such testing as forms the equivalent, with respect to gas, of the guarantees which exist to ensure that the purchasers of commodities get what they ask and pay for, would result in something helpful to the industry and the community at large. When we are able to publish the evidence of the gas engineering witnesses heard by the Committee, it will be seen that the advisers of the Metropolitan Companies were not governed by narrow or selfish considerations in the case they presented for the deliverance of gas manufacture from onerous and obsolete requirements, while respecting the organic laws of the industry. As it has happened, however, the Committee have chosen to shut out from their purview all wider issues, and confine their consideration to the conditions and circumstances of the three London Gas Companies. Therefore, for the moment, the report and recommendations must be regarded as having no message for any other gas undertakings.

As regards the Companies to which the recommendations do apply, and reading these in the light of the remarks of the report, it is possible to say with truth that, while the Committee offer one great measure of relief in advising the abandonment of purification by the use of lime for the reduction of the sulphur compounds, without requiring the Companies to directly pay for it, and while they are favourable to the relief of the Companies from the minor afflictions of gas-testing tyranny, as imposed by public officials who seem to think that gas is made only to be examined, their treatment of the industrially most important matter of all

—the proper testing for illuminating power—is hopelessly wrong. The Committee have, however, the courage of what they would probably call their opinions; for, having indicated certain lines of policy, they proceed to follow them up to their end. Thus, while recommending that the "London" argand burner No. 1 should be used as it never ought to be used for testing anything else but reputed 16-candle coal gas, made up to this quality by the use of cannel—that is to say, with the larger-sized chimney and at the 5 cubic feet rate—they admit that the effect of this would be to make the South Metropolitan and Commercial Companies' gas appear to be of 13-candle instead of 14-candle power. They confess that the Companies named would reasonably object to this depreciation of the nominal quality of their product; and they go so far as to propose that this objection should be overridden. Does anybody who reads the report believe for one moment that if the London County Council draft a Bill to give effect to the finding of the Committee—as they may, in the event of the Board of Trade declining to take action—they will not seek to penalize the Companies for that extra candle? The whole set of observations of the report on testing for illuminating power is a mass of confusion and contradiction. The Committee stigmatize the use of an argand testing-burner as anomalous; yet they recommend that a burner of this kind, which is admittedly not the most efficient, should continue to be used, provided that it is improperly treated. There is no mention whatever of the Act of 1868, which shows why the selection was made. Again, in one place the Committee hanker after a flat-flame test, only to forthwith dismiss the suggestion as impracticable. Why, in the circumstances, mention it at all? The same with the calorific test. If suitable, why not go further, and define it?

The discountenancing of the portable photometer is sensible; but it is very weakly done. Again, the implied connection between the situation of testing-stations and the distribution of enriched gas is meaningless in the existing state of gas-manufacturing practice. The suggestion, for the first time in connection with the gas supply of London, of testing for the purpose of record only, opens up a question upon which we should not like to pass an opinion offhand. The report is obviously diversely influenced by the weight of various pieces of evidence, but is not in the least like a judge's summing-up, in that it lacks the unifying and elucidating judicial spirit. The Gaslight and Coke Company are held to be justified in resisting, under the present conditions, the forced imposition of a reduced standard of illuminating power, at an exaggerated valuation; but the Committee avoid deciding whether the other Gas Companies were well or ill advised in voluntarily taking a lower standard at the price. At any rate, accomplished facts are to be accepted; and this reflection applies to more considerations than one. It may be remarked in some quarters that if representatives of the Companies object to the result of the inquiry, it will be merely because they have not obtained their own way in everything. This, however, is a cheap kind of criticism, which pays no heed to the merits of the greater issues in regard to which the Committee have either halted between opposed opinions, or have failed to distinguish amidst the mass of evidence laid before them. The report is even open to the interpretation that it was intended to administer a sop in turn to everybody likely to be affected by it, and to a rather indeterminate value in every case. If so, it is no wonder if the usual result has followed, of failing to please anybody. Only one alteration is needed, in point of fact, to adapt the recommendations to the reasonable requirements of the Gas Companies concerned, which ought to have weighed more with the Committee than the criticisms of the London County Council; for the reason that the former are in the business of which the latter are merely supervisors. If the Committee had only taken to heart the principle of the Act of 1868, they would have spared themselves the trouble of deciding as to what is the function of the photometry of gas—whether it is a means of defining a particular make of gas, or something different—and they must infallibly have agreed upon the proper use of the "London" argand burner No. 1, which they have so lamentably misunderstood. Perhaps the gravest fault that will be found with the report is that it shuts the door to all possible cheapening and popularizing of gas, by placing any alteration of its purely nominal quality—which is not pretended to be an essential element of value—in so invidious a light.

Proposed Reorganization of the Board of Trade and the Local Government Board.

It is not surprising that the recommendation should be made, as rumoured last week, that the Government Departments known as the Board of Trade and the Local Government Board should be forthwith reorganized, and given an improved *status* among the public offices. A Parliamentary Committee, with the Earl of Jersey as Chairman, has been considering this matter for the past year; and it is understood that the Committee are agreed upon the following points: That the President of the Board of Trade should be paid a salary of £5000 a year; that the Parliamentary Secretary should have £1500, and the Permanent Secretary £2000. In order to indicate more clearly the functions of the Department, the Committee think it might be deemed desirable to give its head the title of Minister of Commerce and Industry. As to this suggestion, the objection arises that the style is not English. We have no State officer whose title begins with "Minister," which is a foreign style that carries with it the further suggestion of a "portfolio." The title "Secretary "of State for Trade and Industry" would agree better with the terminology of the other parliamentary administrative organization, on which the Cabinet system is erected.

It is remarked that the present constitution of the Board of Trade is obsolete; and therefore the Committee do not recommend its continuance. They understand that the Board never meets, and that the sole responsibility for the conduct of its business rests with the President, who ought always to be one of the Cabinet. Generally speaking, the recommendation for elevating the position of President of the Board of Trade to the rank of a principal Minister of State is inspired by recognition of the strong feeling which prevails with regard to this matter among the most influential representatives of the commercial and industrial interests of the country. This is no doubt the case. There exists the impression that these minor offices in British Governments are liable to be treated as the spoils of Party victory at the polls, and consequently to be handed over to hack politicians "with claims," as the saying goes—meaning commonly a record for speech-making or lobbying, of no earthly use in administration. If the head of the Government Department which has most to do with railways, the merchant marine, harbours, gas and water supply, labour matters, and tramways and electric light, were a statesman of the first rank, it is possible that the shortcomings of the Board might be less frequent. After all, however, the greater part of the work of the office falls upon the permanent officials, who deserve better pay than they get, as a rule. If many of the sinecures for old Trade Unionists in the overrated Labour Department were allowed to lapse, and the amount of the salaries thus saved divided among the remainder of the staff, it would be a double advantage.

With regard to the Local Government Board, it is not considered desirable to make any organic change in the organization of the office, but simply to raise the salaries of the chiefs. The Board already consists of members of the Cabinet; and the action of Parliament in recent years has been in the direction of creating fresh Boards similarly constituted—as, for example, the Board of Agriculture by the Act of 1889. It had been proposed to separate matters relating to public health from the other duties of the Board, and entrust them to a distinct staff under a Minister or Secretary of Public Health. The Committee, however, are not disposed to adopt the proposal, probably because, in point of fact, the general duties of the Local Government Board are so bound up with the proceedings of local sanitary authorities that it would be practically impossible to disentangle them. Unless there is some clear advantage to be gained by the proceeding, it seems unbusinesslike to cut about and upset the work of a public department merely for the reason that its composition might be more modern, or because its name is not strictly appropriate.

Oxygen in Incandescent Lighting.

If there were certain things in the lecture by Professor Harold B. Dixon that some of the members of the Institution of Gas Engineers did not fully appreciate at the moment, there was one that, beyond all possibility of doubt, he made clear to everyone present; and this was that the burning of a highly

explosive mixture is one of the best means to develop light from gas. The demonstration which carried strong conviction to his audience was when, by mixing oxygen with coal gas in an incandescent burner, he developed from the mantle a light of exceeding great brilliance; explaining to those who saw, marvelled, and applauded, that coal gas fed with oxygen may be made to burn on a mantle, and give a light roughly of 200 candles for a consumption of 2 cubic feet of coal gas per hour. But it was not remarked that he mentioned how much oxygen would be consumed; and that is an important consideration. Whether the proposal can be made commercially successful depends on several things; the price and consumption of the oxygen being among the number. Oxygen, Professor Dixon says, has been made on the large scale at a cost of about 5s. per 1000 cubic feet; and he sees no reason why it should not be made for half that price. But it has not yet, so far as inquiries lately made in London go to show, been made for "half" the price named. Those who take sufficient interest in our "Register of Patents" to note the nature of all the contents will remember that, within recent times, two incandescent burners have been described specially constructed for burning a mixture of coal gas and oxygen in the manner suggested; and in the trial of one of these burners, we have been interested.

Some Experiences.

This short reference to that trial is not intended to throw cold water on Professor Dixon's proposal to dull its splendour; something more than the recounting of a few difficulties will be required to banish the remarkable effect from the minds of the 300 or so gas engineers who witnessed the demonstration last Wednesday. As already said, the burner, with which the private trials were made lately in London, was of special construction, so that the coal gas and oxygen only came into contact at the point of combustion. No air was admitted. The result was a light of great intensity. We are not allowed to publish the figures derived from the trials; but generally the result was this: Quotations were invited for the supply of oxygen in cylinders in large quantities; and, taking the price quoted, it was found that the consumption of oxygen was so considerable that the total cost per unit of light worked out to rather more than the cost of an equal amount of light obtained by means of well-known high-pressure gas systems. That was the first experience, be it marked though, with the particular burner under test. The consumption of oxygen in Professor Dixon's experiments may have been lower than in the tests here alluded to; it would be interesting to know. Then in respect of wear and tear on the mantles compared with high-pressure gas systems, there was little difference. The next difficulty that one saw was with regard to the supplying of the oxygen to the burners. The possibility of high-pressure gas distribution has been already proved; and it may not be long before it is more generally among us. But what of the distribution of oxygen? There cannot well be a separate supply of it through the streets for perhaps a limited use in the case of those who prefer to employ it in conjunction with coal gas for securing the greater illuminating power at a price, according to these tests, rather higher than with high-pressure ordinary gas alone. The alternative is the supply of gas in cylinders. In the tests referred to, it was also necessary to conduct the oxygen to the special burners by a secondary system of gas tubing, which is not simplifying the system of gas lighting. Two taps—the oxygen and the coal gas—had to be carefully regulated in order to get the maximum lighting efficiency; and it was found necessary, with changes of pressure, to again regulate them. These are, generally stated, among the experiences of these recent private tests; and they will be useful to anyone who may be looking into the matter with a view of putting into practical shape the proposal of the brilliant lecturer of last Wednesday. Everyone will rejoice if better experiences can be realized than those secured by the tests in which our interest was invited; and experimenters will please note this, in anticipation of the time when their results are ripe for publication.

The Astonishment of the "Daily News:"

In addition to the great amount of interest aroused among those connected with the gas profession by the able address delivered by Mr. H. E. Jones to the Institution of Gas Engineers last week, the points brought out would appear to have met with some attention in other quarters. At any rate, the "Daily News"—to which, it may be admitted, one is not in the habit of turning for authoritative opinions on matters with which our readers are mainly interested—has discovered what it says is a "most extraordinary statement," which "seems to conflict completely with our common experience." This statement is the quotation of some "JOURNAL" figures, to the effect that out of 76,000 street-lamps in London, 71,000 are still lighted by gas. The reason for our contemporary's astonishment is not difficult to understand, for the proportions which the two lights bear to one another are indeed remarkable. The question involved, however, is one of fact, and not of theory; and our contemporary has a simple means at hand of settling any doubts which it may still harbour as to the comparative insignificance of the part which electricity is called upon to play in the illumination of the streets of London. This means is a reference to the articles which appeared in the "JOURNAL" a few months ago (based upon official information), from which Mr. Jones stated that he had taken his figures. Or our contemporary can adopt the more roundabout method of appointing a Special Commissioner to pass through all the streets and note the kinds of lamps in use, when, of course, the same conclusion would be arrived at. The newspaper in question may, however, without going to any further trouble in the matter, rest assured that the statistics are correct, and that the "most extraordinary statement" to which it draws attention is but one more example of the truth which is (to some people) stranger than fiction.

Some Results

The shock sustained by the "Daily News" on reading this portion of Mr. Jones's address must have been a severe one, for the—to say the least—inconsequential character of its remarks upon the subject bear evidence of an acute attack of "nerves." After saying that, if the statement referred to be true, 5000 electric lights seem to produce as much illumination as 71,000 gas lights, the assertion is made that London does not give the advocates of gas much cause for boasting, as it is one of the worst lighted cities in the world, though the lighting of the centre portion has much improved. In so far as there may be truth in the contention that other cities are better lighted than London, the fault cannot possibly rest with the Gas Companies, seeing that (though our contemporary is in all probability totally ignorant of the fact) in places which are usually cited as examples to be followed in this respect electricity plays an even smaller part than it does in the Metropolis. Alluding to "that vast grey mass of Greater London, with its ocean of slums and little villas," which "is a land of Stygian gloom," the "Daily News" says the Gas Companies may well feel proud of the skill with which they keep their hold on these districts. They do feel proud of it; but for this, thanks are not "due to the little Borough Councils, which are entrusted with the responsibility for lighting," but to the immense superiority in every respect, when used to the best advantage, of what the Gas Companies have to offer over anything that the electricians can furnish. The action of these Councils, in keeping to the older illuminant (burnt under new conditions), does not constitute "shameful remissness that leaves greater London to darkness modified by a few scattered gas-jets," but is prompted by sound commonsense and consideration for the pockets of the ratepayers.

And Admissions.

In the very next sentence, the "Daily News" seems to fully bear out our view of the matter, by the admission that gas engineers have manfully faced the task of competition, and that the incandescent system is an immense improvement on the old flat-flame burners. Exactly; there is the whole case in a nutshell. But our contemporary immediately proceeds to rob us of the opportunity of congratulating it on the soundness of its view, by adding that the incandescent gas system forms an excellent light in certain districts where electric lamps would be too powerful. Is this last word a joke or a misprint? On first consideration, it occurred to us that the compositor must have read the word "powerful" for "expensive;" but on further reflection we were forced to abandon this explanation, as it is not only in "certain districts," but everywhere, that the electric light is "too expensive." We must therefore regard it as a joke, and do our best to smile at the suggestion of solemn councillors rejecting the electric

light on the ground of its being "too powerful." After asserting that electricity is superior to gas in illuminating power, cleanliness, safety, and (if its use is well controlled) cheapness, the writer of the article asks, "Why, then, does electricity make so little progress for internal lighting?" So even its dear old friend the "Daily News" admits that the progress made is slow! This shows at least that our contemporary is a little better informed on the subject of electricity than on that of gas; though even here the knowledge displayed is not overwhelming, for the answer given is that the slow progress is due to the "amazing strength of custom, which still clings to gas as the light which lit our fathers." If that were true, it would be difficult to explain how it was that our fathers did not cling to the candles and lamps that lit their fathers. It is a pathetically weak excuse; but so long as it satisfies our electrical friends, there is no particular reason why we should quarrel with it—or even suggest the possibility that electric lighting is "too powerful" for internal illumination.

Municipal Savings Banks

The impossibility of raising money on the easy terms of a few years ago is driving municipalities into new and strange courses. At their meeting last week, the Devonport Corporation were invited to adopt a scheme for receiving on deposit small sums of money repayable at short notice. The idea, it was explained, was to receive small loans at 3 per cent. per annum, repayable at seven days' notice, and to issue mortgage bonds when the deposits amount to £50. This plan for competing with the savings banks and with the bankers in general, which appears to be spreading, did not pass altogether unchallenged. It was pointed out that, with seven days' notice, the deposits would practically be repayable on demand, and that this would involve a certain amount of risk of financial disaster. Contrary to the accepted principles of sound banking, the Corporation were not making any provision for a large cash reserve; and, in the event of an unexpected demand for repayment, they might find themselves in a position of considerable difficulty. Another objection taken to the scheme was that it meant an entirely new departure in competitive municipal trading. Why, it was asked, should the Corporation enter into rivalry with the bankers any more than with the drapers or the butchers? If there was to be a Corporation savings bank, what was to prevent the opening of a municipal draper's shop? A distinction was sought to be drawn between the municipal trading which becomes competitive and that which deals in monopolies like gas, water, and electric light, though the distinction is not so great as those who used the argument seemed to imagine. Perhaps because bankers are, as a rule, well able to take care of themselves, the members of the Council did not seem greatly impressed by the contention that this was a new departure in municipal trading. The reply was, in effect: "We are already municipal traders, and a little more of it cannot matter, especially as considerable advantage may accrue from it." And so the Corporation are to try the scheme, with whatever risks it may involve; and to the growing list of municipal trading concerns there will possibly come to be added at an early date the Corporation savings bank.

And Insurance.

This is, however, not the only development of corporation financial risks which is now under discussion; for we notice that the municipal insurance scheme which was some time ago carried into effect by certain of the Metropolitan local authorities so far met with the approval of the Bradford City Council that they determined to call a conference of representatives of corporations in the West Riding of York and in Lancashire for considering the adoption of the principle. This gathering took place last week; and a decision was arrived at to join the scheme now in operation in London, and for this purpose to establish a North of England Local Board or Branch, for all authorities in the counties of Yorkshire, Lincoln, Nottingham, Derby, Cheshire, and north thereof. It is to be presumed that all the advantages and disadvantages of the proposal were fully gone into; but nevertheless this new departure seems to be fraught with a very considerable amount of risk, and in this connection it may be pointed out that a Committee of the Corporation of London a short time since reported adversely to the adoption of a scheme for undertaking the insurance of the buildings in their area. For a time the corporations joining the new branch will pay over to the fund to be created the amount they have hitherto paid the insurance companies; but it is calculated that at the end of five years the accumulation of money will justify some reduction, and that the premiums will be a gradually diminishing quantity in successive years. Should there be no serious conflagration until the fund has reached substantial dimensions, the idea will no doubt work out all right; but if a large fire should break out before there has been time to accumulate any money, the corporations will in all likelihood wish they had the insurance companies to fall back upon. It is stated that all the corporations who join the movement will underwrite the policies, so that any losses suffered before the fund has grown large enough to bear the strain will be guaranteed; and, of course, the larger the number of corporations who combine the nearer will the risks undertaken coincide with the business carried on by an insurance company. It remains to be seen, however, whether the saving in premiums will anything like compensate for the additional financial responsibility incurred.

WATER AFFAIRS.

Water Engineers in Conference at Hull.

By a rather singular coincidence, the members of the two organizations representing the technical side of the industries with which the "Journal" is specially identified held their annual meetings last week, and discussed questions of considerable moment, not only to themselves, but to the communities they serve. Just as the meeting of the Institution of Gas Engineers in London, the proceedings at which occupy so large a portion of the present issue, was drawing to a close, those of the British Association of Water-Works Engineers, at their meeting in Hull, were being opened by Mr. F. J. Bancroft, B.Sc., the Water and Gas Engineer of the Corporation of that city. As many gas engineers have also the control of water-works—the President himself is a good example of this—a double attraction was presented by the programmes prepared for the two meetings; and these will possess the greater interest to them in proportion to the extent to which the supply of gas or water enters into the duties they are called upon to discharge. Whichever branch of the industry may bulk the larger, as our friends north of the Tweed would say, in his daily work, the two meetings will afford plenty of matter for the thoughtful consideration of every manager. The work of the gas engineers having been so fully discussed elsewhere, we have only to deal here with the gathering of their professional brethren over which Mr. Bancroft presided. It was the ninth annual meeting of the Association; and, in point of interest, we think it will be acknowledged that it had not been surpassed by any of its predecessors. It was opened with a cordial welcome extended to the Association by the Mayor, Alderman Jarman, who spoke in appreciative terms of the President and his work. The technical business was preceded by an instructive address from the Chair; and it was followed by papers on subjects of the highest importance to water engineers. An abstract of the address will be found, with the general report of the proceedings, in another column; and the papers and discussions will be dealt with in subsequent issues of the "Journal."

Mr. Bancroft commenced his address with an allusion to the satisfactory proof of the usefulness of the Association afforded by the growth in the membership, which during the past year was brought up to a level 300. The gentlemen whose names appear on the roll have the management of works in which something like £56,000,000 of capital has been invested; and a population numbering 14 million rely upon these works for a supply every day of 444 million gallons of water. With such responsibilities as these, upon the efficient discharge of which depend so largely the health, happiness, and prosperity of the community, how necessary it is that those upon whom they rest should meet periodically for the purpose of discussing subjects bearing upon this important work, and by social intercourse adding to the general stock of knowledge. This was the object for which the Association was formed; and Mr. Bancroft pointed with gratification to the progress made and the work done, in the eight years of its existence, as a recognition of the value of such an organization. After a brief reference to the subjects

of the standardization of cast-iron pipes and the revision of water-supply regulations, both of which have received due attention from Committees, the President proceeded to consider a question of great moment in the work of water engineers—the daily consumption per head; and he brought his personal experience to bear upon it. It is on such a subject as this that a man in Mr. Bancroft's position, engaged in the practical, every-day work of water supply, can speak with far more authority than an easy-chair theorist. What is, or will be, the daily consumption of water per head? He thinks that in large towns 50 gallons will probably be the standard in the near future; and that in small towns and rural districts an average of 30 gallons, with a maximum of 36, should be sought. Where is the water to come from? This was the question next considered; and again the President's personal experience was related for the benefit of his professional colleagues both within and outside the ranks of the Association. This experience has been obtained chiefly in connection with supplies from the chalk; and his remarks on the water-bearing capacity of this stratum should be read with attention. The only water really available for supply is that which passes through the interstices and fissures of the chalk; so that whatever portion of this is not captured and utilized, flows away into the rivers and the sea. The obvious course, therefore, to prevent this waste is to sink wells, pump up the water, and store it. True; but where and how? These were the questions which the President proceeded to answer in the next portion of his address, in which he dealt with the position to be chosen for wells, the types of engines in use for pumping, and the capacity of service reservoirs. Having secured his water, he passed on to the subject of its distribution, by offering a few remarks on the position of mains. He advocates the removal of all mains from under tramlines; trunk mains being laid at the side of the carriageway, and the footways being used for the service mains. He considers that each undertaking using the public thoroughfares should have a definite position assigned to it in which to put down its conduits. Here the President spoke as much in the capacity of a gas as of a water engineer; and the attention of the members of the Association may be usefully directed to the paper on this subject read by Mr. Broadberry at the meeting of the Institution of Gas Engineers on Thursday, the full text of which, with the discussion thereon, will be given in the "JOURNAL" next week.

From matters specially connected with the detail work of water-works engineers, the President proceeded to consider the more general questions affecting them. "What," he asked, "is the most pressing need of water undertakings, the "urgency of which is felt by all concerned in the manage-"ment of water-works?" Probably there was not one among Mr. Bancroft's auditory who was not ready with the answer which he himself gave to his question—viz., that there should be a department of the Local Government Board solely devoted to water supply. We need not follow him in giving the reasons he adduced in justification of the constitution of such a department, as they are pretty generally known. Furthermore, it should be the duty of the paramount authority to, if necessary, compel the formation of Joint Boards to deal with groups of towns and villages which, owing to their position and surroundings, can only be effectively dealt with by one scheme. Another subject calling for attention is that of underground water, much of the prevalent uncertainty and rivalry in regard to which would, it is thought, be obviated if there were in existence an authority entrusted with the general welfare of the water supply of the country, taking wide views, and having and exercising control in these matters. Then there is a manifest absence of uniformity in the powers of water authorities, both in regard to the sources and supply of water and the regulation of its use by consumers. Finally, there is the necessity for some alteration in the existing bye-laws and regulations for preventing the waste and misuse of water; and the opinion is held that annual returns should be furnished from all water undertakings, giving particulars in regard to levels, storage capacity, quantity supplied, and other matters, similar to those now made to the Board of Trade with respect to gas undertakings. All these matters, as Mr. Bancroft pointed out, have been brought before the President of the Local Government Board. They constitute a rather large "platform." But it has not been constructed by the Association only; they have had the co-operation of the Sanitary Institute, the County Councils Association, and also the Underground Water Preservation Association. When bodies having interests so divergent are brought together for the purpose of concerted action, there certainly seems, as the President remarked in closing his address, a pressing need of fresh legislation dealing comprehensively with the water supply of the country. There has been no general legislation on this subject since 1847; and the time is certainly ripe for the consolidation of the various existing enactments into a new General Water Act.

What, it may be asked, are the prospects of the abovementioned objects being achieved? Judging by the report of the Committee which has been considering, under the chairmanship of Lord Jersey, the position and duties of the Local Government Board, there does not seem to be any probability of a separate department being constituted for the purposes indicated by Mr. Bancroft; while the transference of the work of the Board which bears directly upon public health—including, as a matter of course, the supply of water—to a distinct staff, under the direction of a Parliamentary Secretary and a Permanent Secretary for Public Health, which was suggested by Sir Michael Foster, is not approved by the Committee. This "plank" of the platform—and it is a rather broad one—is consequently a little loose; but, by judicious "joinery," or, in less metaphorical language, continued combined action, it may be rendered more secure. If all the objects sought cannot be attained, some, at all events, may be; and an opportunity for further action will, no doubt, be presented when a movement is made to give legislative effect to the Committee's recommendations. Meanwhile, we shall see what will be the scope of Mr. Long's promised Public Health Bill. With regard to the standardization of water-fittings, the codification of existing water-works regulations, and the registration of plumbers, there appears to be good reason for expecting a satisfactory result from the labours of the Joint Committee of water-works engineers, architects, and others—upon which, by the way, the Association is liberally represented—appointed after the conference convened by the Plumbers' Company last November. In compliance with an invitation sent out, a meeting of leading manufacturers has lately been held, at which representatives of four firms were selected to serve on the Committee. It may be hoped, therefore, that some really practical recommendations will be submitted.

Leaving detailed notice of the papers until they are given, it only remains to say that the social features of the meeting came as agreeable reliefs to the business. The cordial welcome offered by the Mayor was supplemented by a luncheon at the Town Hall, the Council Chamber of which had been placed at the disposal of the Association. The President's smoking concert allowed of some very pleasant social intercourse between the members; while the dinner was a fitting occasion for giving expression to their appreciation of the hospitality extended to them by the Corporation. An opportunity was afforded of inspecting the President's pumping-stations at Springhead and Cottingham, and hearing from him something about them. A far more extensive object-lesson was, however, in store for those who decided to carry out the supplementary programme, and spend this week in Belgium. The visit will bring to a close a thoroughly successful meeting, due in a very large measure to the personal qualities of the President and the organizing capacity of the Secretary (Mr. Percy Griffith); and it may be hoped that it will prove both pleasant and profitable.

The Award in the Hucknall Huthwaite Gas Arbitration.—At the meeting of the Hucknall Huthwaite District Council last Wednesday, the award of the Umpire in the Hucknall arbitration (Mr. A. J. Ram, K.C.) was announced. The proceedings were reported in the "JOURNAL" for the 8th of March (p. 639). The South Normanton and Blackwell Company asked for an award of £6324. The value put upon the property by Mr. Corbet Woodall was £7275; Mr. J. H. Brown, of Nottingham, giving the figure of £2990, *plus* £567 for outside mains and excess works. Under the award, the Company, for whom Mr. W. A. M'Intosh Valon was Arbitrator, will receive £4280 *plus* £912—together, £5192—from the Council, who placed their case in the hands of Mr. E. K. Burstal. The proceedings at the meeting of that body at which the amount of the award was announced were conducted in private; but there is a feeling locally that the greater part of the sum named might have been saved had more discretion been used by certain members.

REPORT OF THE DEPARTMENTAL COMMITTEE APPOINTED TO INQUIRE AND REPORT AS TO GAS TESTING IN THE METROPOLIS.

At a Meeting held in the Council Chamber, Whitehall, on the 25th of January last, at which the President of the Board of Trade (the Right Hon. Gerald William Balfour, M.P.) was present, the Board appointed the following gentlemen—viz.,

The Lord Rayleigh, F.R.S. (*Chairman*)
Sir William de W. Abney, K.C.B., F.R.S.
Robert Farquharson, Esq., M.D., M.P.
William King, Esq.
J. Fletcher Moulton, Esq., K.C., M.P.

to be a Committee to "inquire and report as to the statutory requirements relating to the illuminating power and purity of gas supplied by the Metropolitan Gas Companies, and as to the methods now adopted for testing the same, and whether any alteration is desirable in such requirements or methods, and, if so, whether any consequential alteration should be made in the standard price of gas." The Board also appointed Mr. H. C. Honey to be Secretary to the Committee. Their report (as follows) was presented to Parliament by the Board of Trade last Tuesday.

To the Right Hon. Gerald William Balfour, M.P., President of the Board of Trade.

Sir,—This Committee having been appointed by the Board of Trade, by a minute dated the 25th of January, 1904, "to inquire and report as to the statutory requirements relating to the illuminating power and purity of gas supplied by the Metropolitan Gas Companies, and as to the methods now adopted for testing the same, and whether any alteration is desirable in such requirements or methods, and, if so, whether any consequential alteration should be made in the standard price of gas," have the honour to submit the following report and recommendations.

1. The Committee have sat on twenty-one days, and have carefully considered the various matters relating to the testing of gas in the Metropolis, which are included in the reference made to them, and have heard evidence thereon from the Metropolitan Gas Referees, and from representatives of the London County Council, the Corporation of the City of London, and each of the Gas Companies concerned—namely, the Gaslight and Coke Company, the South Metropolitan Gas Company, and the Commercial Gas Company.

2. The existing system of gas testing in the Metropolis and the statutory provisions under which it is regulated, are set forth in the Memorandum prepared by the Board of Trade and in the statements handed in by several witnesses, and need not be here described in detail.

3. The Committee have carefully considered whether the increasing proportion in which gas is being used for heating, as compared with illuminating purposes, renders it desirable that any fundamental alteration of the existing requirements should be made, such as the combination of a standard for calorific power with one for illuminating power, or the abolition of a standard for illuminating power and the substitution of a calorimetric standard.

4. Although a large part of the gas used for lighting purposes is used with incandescent mantles for which the illuminating power of the gas is in itself of no value, a considerable proportion is still consumed in flat-flame burners; and while this is the case the Committee feel it is desirable that testing in respect of illuminating power should be maintained. At the same time, it is clearly anomalous that while such testing is only required in the interests of those consumers who continue to use flat-flame burners, the tests should be made with an argand burner, which is of a wholly different type, and is practically never used by the public. The Committee did not, however, see their way in existing circumstances to suggest the prescription of tests, which would involve forfeitures, either in respect of illuminating power in a flat-flame burner, or in respect of calorific power; but they recommend that official tests in these respects (supplementary to the existing tests, but not for purposes of forfeitures) should be made in such manner, and to such extent, as the Gas Referees prescribe. The results of these tests should be recorded, and will form a valuable guide for future action.

5. The prescribed illuminating power of the gas supplied by each of the three Companies was until recently 16 candles. But the South Metropolitan Gas Company and the Commercial Gas Company have obtained the sanction of Parliament to the supply of gas of a nominal illuminating power of 14 candles; the Gaslight and Coke Company being now the only one required to supply 16-candle gas.

6. It has been suggested by the London County Council that a uniform standard of illuminating power should be imposed on the three Companies. A consideration of the evidence, however, leads the Committee to the conclusion that the supply of an inferior quality of gas is of doubtful advantage alike to the Companies and the consumers. The reduction in price which can equitably be required from a Company cannot well be greater than the consequent saving in cost of manufacture; and this does not appear to be sufficient to make up for the loss to the consumers in the value of the gas supplied to them. They are, therefore, clearly of opinion that no reduction of illuminating power should be imposed upon the Gaslight and Coke Company so long as the present conditions of gas supply exist; and, on the other hand, they consider it impracticable to re-open the question so far as the South Metropolitan and Commercial Gas Companies are concerned.

7. With regard to the standard burner prescribed by the Special Acts—namely, Sugg's "London" argand burner—no suggestion has been made that it is not suitable for testing the illuminating power of different qualities of gas when used under properly defined conditions. It is admitted that the maximum amount of light obtainable from the gas is not produced by this burner; but, having in view the fact that it is being used at the present time for testing the gas of all three Companies, and of the importance of uniformity in the standard burner, the Committee do not propose any alteration in this respect. The question of the substitution of a flat-flame burner for the argand burner is not one which, in the absence of the necessary data, can usefully be considered at present.

8. Great difference of opinion exists as to the method in which the standard burner is to be used; and the statutory provisions in this respect are different for the different Companies. The Gaslight and Coke Company are required to supply such gas as will produce, when consumed at the rate of 5 cubic feet per hour in the standard burner, a light equal to 16 candles. The South Metropolitan Gas Company are required to supply gas of a nominal illuminating power of 14 candles, which is to be tested by being burnt in the standard burner at such a rate as shall give a light equal to 16 candles—*i.e.*, at a rate of 5·71 cubic feet an hour. In the case of the Commercial Gas Company, their Act of 1902, which authorized the reduction of illuminating power to 14 candles, made no special provision with regard to testing. Hence the condition that the gas was to be burnt at the rate of 5 cubic feet per hour was taken to be still in force, and when so burnt the gas was required to produce a light equal to 14 candles. Under these conditions, the illuminating power of the gas would have to be about 1 candle higher than that prescribed in the South Metropolitan Gas Act, 1900. By their Act of 1903, however, a similar provision to that applicable to the South Metropolitan Gas Company was, by agreement with the London County Council and in view of the appointment of this Committee, made temporarily applicable to the Commercial Gas Company; the operation of the Act being limited to a period of three years.

9. It is not seriously disputed that the requirement that the gas shall be burnt at the rate of 5 cubic feet an hour is satisfactory as regards gas of a nominal illuminating power of 16 candles, such as is supplied by the Gaslight and Coke Company; but in testing gas of the quality supplied by the other two Companies, this method gives a lower nominal value to the gas than would be given if it were tested by the method prescribed for the South Metropolitan Company. The gas which, when tested by the latter method, would have an illuminating power of 14 candles ascribed to it, would, by the former method, be accorded a nominal illuminating power of only 13 candles.

10. There is naturally an objection on the part of the South Metropolitan and Commercial Gas Companies to a method which would affix a lower denomination to their gas; and their witnesses strongly contend that the method now in force more accurately represents the true illuminating value of the gas in comparison with the 16-candle gas which they were formerly required to supply.

11. The issue would be of greater importance to the Companies if it were proposed to alter the actual quality of the gas they are required to supply. This is not the case. The matter is solely one of nomenclature. The question is whether it is better to call the gas 13-candle gas because when burnt in the same burner and at the same rate as that adopted for the 16-candle gas it gives the lower figure, or to call it 14-candle gas because it gives 14 candles per 5 cubic feet when burnt at a proportionately greater rate.

12. It appears to the Committee that, in selecting the method to be adopted for testing, the object to be aimed at is not so much to measure the relative values of different qualities of gas as to define the quality of the gas without ambiguity. This is best accomplished by giving in each case its illuminating power when burnt under known conditions; and it is desirable that the conditions under which it is burnt—*i.e.*, the method of testing—should be uniform as regards all qualities of gas.

13. The Committee have, therefore, come to the conclusion that the definition of the illuminating power of the gas should in the case of each of the Companies be arrived at by taking the number of candles obtained by burning the gas in the standard burner at the standard rate of 5 cubic feet per hour. The

numbers so obtained will define the quality of the gas simply and clearly, whether or not they give a correct measure of its value to the consumers.

14. The mode of carrying out the test may be left as at present, to the prescription of the Gas Referees.

15. The existing test for sulphuretted hydrogen is a very severe one; and, in the opinion of the Gas Referees and many other witnesses, the requirements of the Special Acts, that the gas shall be wholly free from sulphuretted hydrogen, may safely be made less stringent. The Committee concur in this view, and consider that a three-minute test with moistened lead paper—such as that prescribed by the Gas-Works Clauses Act, 1871—would sufficiently guarantee the practical freedom of the gas from this form of impurity. The Committee are of opinion that such a test, if made not less than twice a day at intervals of not less than two hours, with gas flowing at the rate of 5 cubic feet per hour at a pressure of 1 inch, would be an adequate one. The mode of testing should be left to be prescribed by the Gas Referees as at present.

16. With regard to the injurious effects of the presence in gas of sulphur compounds other than sulphuretted hydrogen, the evidence is conflicting. But it is not disputed that only a small percentage of the gas undertakings in the United Kingdom (whether in the hands of companies or local authorities) are required to take these sulphur products out of the gas they supply. Nevertheless, it does not appear that any complaints are made by the inhabitants of other districts on the ground that the gas thus unpurified causes injury to health or is more destructive to articles such as leather, &c., than it is supposed to be in London. In the face of this striking fact, the Committee are of opinion that those who contend for the maintenance of the clauses relating to sulphur compounds (other than sulphuretted hydrogen) have not sufficiently shown that their abolition in the case of the London Companies would be detrimental to the public. On the other hand, all the witnesses on behalf of the Companies have spoken with much emphasis of the anxiety caused to the management on account of the uncertain action of the lime purifiers and the knowledge that the slightest excess of impurity will render them liable to the odium of Police Court proceedings; and they have laid much stress upon the nuisance to the neighbourhood which they contend is inevitable when purification is done by means of lime. And there is no doubt that the nuisance which is occasioned by the use of lime for extracting these sulphur products is very serious, not only by reason of the annoyance caused to the neighbourhood, but also by the deleterious effect on the workmen employed in connection with the process.

17. After careful consideration of the evidence submitted to them on this question, the Committee are of opinion that the requirement that the sulphur impurities shall be removed to such an extent as to demand the use of lime shall be discontinued; and, in view of the fact that no effective substitute for lime has been found, they abstain from suggesting the imposition of any modified restriction in place of that now existing.

18. The Committee recommend, however, that official tests should continue to be made, and that the amount of impurity in each form in the gas should be ascertained and recorded.

19. The relaxation of the requirements with respect to sulphur purification will undoubtedly be a great relief to the Companies, to whom the existing tests cause great trouble and anxiety; but the Committee do not think that the pecuniary advantage is, in itself, sufficient to justify them in recommending any consequential reduction in the standard price of gas. The Committee suggest, however, that the removal of these onerous regulations would furnish an appropriate occasion for revising the present arrangements of the sliding-scale, and substituting for them arrangements in which the standard price and the rate of variation of dividend would be fixed so as to give the Gas Companies greater incentives to economy, while being equally favourable to the public under normal circumstances. In revising the arrangements, it would be well to bear in mind that the larger proportion of gas consumed is even now used for purposes for which the calorific value is the important point.

20. The question of the amount of ammonia to be allowed, which at present depends upon the prescription of the Gas Referees, has given rise to no difficulty; and it appears to the Committee that it may be left to the Referees to prescribe such limitation of the amount to be allowed, and such tests in respect of this form of impurity, as they think necessary.

21. The existing requirements and tests with respect to pressure do not appear to be considered unsatisfactory; and the Committee see no reason to offer any observations thereon.

22. Complaint has been made by one of the Companies with regard to a requirement of the Gas Referees under which the gas to be tested is to be brought direct from the main to the testing-place by single service-pipe without tap or branch or provision for connection of any kind outside the testing-place. The Committee are of opinion that the requirement in question is a reasonable one, and that it might with advantage be made a statutory regulation not dependent upon the prescription of the Gas Referees.

23. Some suggestions have been made that the existing testing-stations do not adequately provide for the testing of all the gas sent out from the various works. Under the existing statutes, the Gas Referees are required to prescribe and certify the situation and number of the testing-places to be provided; and the Committee consider that the statutory provisions in this respect are satisfactory.

24. The views expressed in the preceding paragraphs with respect to the direct service-pipe and the number of testing-places, appear to the Committee to furnish an answer to the proposal made on behalf of the London County Council to legalize the use of the portable photometer for penalty testing. The Committee are of opinion that so long as permanent forms of enrichment, such as those now used by the London Companies, are employed, the existing law provides ample machinery and opportunity for testing the bulk of the gas supplied by each of the Companies, and that there is no need for further provisions. The Committee are not therefore prepared to recommend the adoption of the further tests proposed.

25. Evidence has been placed before the Committee relating to the recent decision of the Courts which requires the testing of gas to be carried out on Sundays as on other days. The Committee do not think that any advantage is gained by making it obligatory upon the controlling authority to test on Sundays.

26. It would appear that there has been considerable friction between the Gas Referees and the Gas Companies owing to the latter considering that some of the requirements of the Gas Referees were unreasonable, and refusing to obey them. The Committee recommend that if such disputes arise they should be referred to the Chief Gas Examiner, and that his decision should be conclusive and binding on both parties.

27. The apparatus described by the Gas Referees for use in the testing-places and the mode of testing have not been challenged in any other respects than those already mentioned.

28. There is general agreement that the provisions which define the duties of the Chief Gas Examiner should be reconsidered; and it has been urged by the Gas Companies that those duties should include the assessment of forfeitures incurred in cases where deficiency of illuminating power, excess of impurity, or insufficiency of pressure has been reported by the Gas Examiners. Strong representations have been made against the existing procedure, under which the forfeitures are recoverable only by means of proceedings taken by the controlling authorities against the Companies in the Police Courts. The Committee have had the advantage of hearing evidence from the London County Council on this matter, from which it appears that the Council would be disposed to assent to a modification of the existing provisions, whereby, in future, Police Court proceedings will not be required when the Chief Gas Examiner shall certify that the default reported by the Gas Examiner is not substantial, or that it is not due to careless conduct of the works; the forfeitures in all such cases being left for assessment by the Chief Gas Examiner.

29. The Committee recommend that the existing statutes should be modified to this effect, with due provision for the recovery of the forfeitures from the Companies, and for their allocation. No alteration should be made in the provision at present in force, that "no forfeiture shall be incurred in any case with respect to which it is certified by the Chief Gas Examiner that the defect of illuminating power, excess of impurity, or insufficiency of pressure was occasioned by an unavoidable cause or accident." Before commencing any proceedings before the Chief Gas Examiner, the controlling authority should be required to give notice to the Gas Company concerned.

30. The Committee accordingly recommend—

(*a*) That the standard burner to be used for testing the illuminating power of all qualities of gas should remain, as at present, the Sugg "London" (No. 1) argand burner, and that the chimney to be used therewith should be of uniform size—namely, six inches long and one and seven-eighths inches internal diameter.

(*b*) That for the purpose of determining the nominal illuminating power of gas of any quality, the gas should be burnt in the standard burner at the rate of 5 cubic feet an hour.

(*c*) That provision should be made for official testing of illuminating power in a flat-flame burner, of a kind to be prescribed by the Gas Referees, and that the result of such tests be recorded and notified to the various Authorities and Companies concerned and to the Board of Trade.

(*d*) That official tests of the calorific power of the gas supplied by each Company should also be made, recorded, and notified as above.

(*e*) That the existing statutory provision which requires the gas to be wholly free from sulphuretted hydrogen (which is, in fact, impracticable) should be modified, and that for the future the test which the gas should be required to pass should not be more severe than that specified in the schedule to the Gas-Works Clauses Act, 1871.

(*f*) That the obligation placed upon the Companies with regard to the removal of the sulphur impurities (other than sulphuretted hydrogen) should be abolished, but that testing for information only should continue to be made in such manner and to such extent as may be prescribed by the Gas Referees.

(*g*) That the gas to be tested should be brought direct from the main to the testing-room by a single service pipe without tap, branch, or connection.

(*h*) That in case of difference between the Gas Companies and the Gas Referees as to the reasonableness of any requirements of the Referees, the decision of the Chief Gas Examiner should be conclusive.

(*j*) That, except as may be involved in the foregoing recommendations, the powers and duties of the Gas Referees should remain as at present.

(*k*) That it should not be obligatory upon the controlling authority to test on Sundays.

(*l*) That the duties of the Chief Gas Examiner should include the hearing of all applications by the controlling authority for the recovery of forfeitures in respect of illuminating power, purity, or pressure, and the assessments of the forfeitures to be paid by the Company in all cases except those in which he is unable to certify that the default is not substantial, or that it is not due to careless conduct of the works.

31. The Committee desire to record their indebtedness to Mr. Herbert C. Honey, of the Board of Trade, for the very efficient assistance which he has rendered as Secretary.

(Signed) RAYLEIGH.
W. DE W. ABNEY.
ROBERT FARQUHARSON.
WILLIAM KING.
J. FLETCHER MOULTON.

HERBERT C. HONEY, *Secretary*.
19*th May*, 1904.

THE EARL'S COURT GAS EXHIBITION.

Conference between the Advisory Committee and Manufacturers.

IN conformity with a notice issued by Mr. F. W. Bridges, the Organizing Manager of the proposed International Gas Exhibition at Earl's Court, there was a conference yesterday afternoon, at the Holborn Restaurant, between the Exhibition Advisory Committee appointed by the Institution of Gas Engineers and a considerable number of representatives of the manufacturing firms of the gas industry—probably to the number of about sixty. It was in accordance with the fitness of things, that Mr. J. W. Helps, the Hon. Secretary of the Advisory Committee, should be selected for the position of Chairman—he having taken such a pronounced interest in the exhibition, and a large number of the details having passed through his hands. He made an introductory speech of a very appropriate character. The Committee had nothing definite to place before the meeting beyond what has already been published; but it had been called, explained the Chairman, rather for the purpose of putting gentlemen representing the manufacturing side of the gas industry in a position to offer to the Committee such advice and suggestions as might assist in bringing the exhibition to a very successful issue. Mr. Helps thought all present would agree that the time has now arrived when the gas industry has every right to think that such an exhibition is necessary. Speaking of the choice of Earl's Court as the home for the exhibition, he believed those who have been there will agree that the buildings offer very great facilities for the getting together of a large amount of apparatus in connection with the gas industry, and not only that, but the Committee think it is just as central and just as accessible as any other big building that could be obtained. Mr. Clare (Messrs. Fletcher, Russell, and Co.) asked for a short outline of the scheme; and the Chairman responded. He first referred to the preliminary prospectus, which, he says, is still "preliminary," because it takes a considerable time to get the adherence of certain important personages connected with the industry to become Vice-Presidents and Patrons. The prospectus, he pointed out, shows that the Presidents of all the principal Gas Associations on the Continent and in America have, without exception, accepted positions as Vice-Presidents; and they have written offering all the assistance they possibly can in ensuring that the exhibition shall be a success. Plans of the space to be occupied by the exhibition in the buildings were handed round. It was seen that it is not intended, nor will any attempt be made, to occupy the whole of the grounds. It was explained that the Princes' Hall has a very solid floor, and is really the only part of Earl's Court on which they can hope, with any success, to exhibit heavy machinery in motion. Then there is a large T-shaped building ending in the Ducal Hall; and this part of the exhibition is to be devoted principally to the display of gas-stoves and kindred apparatus. The demonstrations in connection with cookery and, it is thought, partly of scientific objects, will be located in the sides of the head of the T building—that is to say, on either side of the Ducal Hall. Passing out from this hall, one comes into the open with the large sheet of water in the centre; and it is intended to devote this space to the exhibition of various forms of public lighting. Then the Queen's Palace will be given over to general exhibits; and here, Mr. Helps observed, it would never do to suggest that such an exhibition as this should be limited in its character. Therefore it is intended to open the Queen's Palace to those who are not absolutely immediately interested in the industry; and the Chairman mentioned that they hope to make an attractive exhibit in connection with tiles, bricks, and such commodities as are supplied by the Minton and Doulton firms—such things being now largely used in buildings on gas-works. The Committee also contemplates having rooms furnished in the latest styles, and lighted and warmed on the latest principles. The main thing is, Mr. Helps abundantly recognized, to make the exhibition as attractive as possible to the general public; because, as he sagely put it, "before we can hope to obtain any lasting result from the exhibition, we must get the people there." It is also intended to secure the services of some of the best bands.

The foregoing may be taken as an epitome of the opening speeches of the Chairman. There was a little hesitation in commencing the discussion from the manufacturers' side of the table. The ice was broken by Mr. T. G. Marsh, who complimented the Institution on having at last, to a certain extent, come out of their shell, and doing something towards carrying out the Bibical injunction of not hiding their light under a bushel. He held that the exhibition ought to be one from which technical information may be obtained by all parties connected with the gas industry; and he hoped that it will be of a character that will act as an incentive to the introduction of new methods and improved styles. He trusted that the Directors of gas companies and members of Corporation gas committees will come forward handsomely and help in this matter, because the success of the exhibition means to those undertakings certainly safe dividends and increased revenue. On behalf of Messrs. T. Glover and Co., Mr. John Glover made a speech very pertinent to the objects in view—promising, in the course of it, the support of his firm. In fact, he went further, and said he felt certain that the whole of the gentlemen present, representing the manufacturers of the gas industry, will be only too glad to help in every shape or form.

This was all encouraging to the Advisory Committee. Then questioning began—Mr. S. Cutler, jun., leading off by inquiring what would be the method of general illumination of the buildings, which is now electrical. It was learnt from Mr. Helps's reply that it is hoped that the electric light will be supplanted by gas to a very large extent. But the expense of fitting up the buildings entirely by gas would be considerable. If, however, any part continues to be lighted by electricity, it will be generated by gas-engines. Mr. H. M. Thornton (of the Richmond Gas Stove and Meter Company) was curious to know if the plan of the exhibition would be adhered to, so as to give exhibitors some assurance that the value of the space they contract for will not be depreciated by alterations. The question of the cost for space was also introduced by him. He thought it was quite an open secret that the charge for the central space in the gas-stove section is to be 4s. per square foot, and for the side spaces in the same section 3s. per square foot. Space sufficient to do justice to his firm and their exhibits would, he said, come to a great deal more than many firms will feel they are entitled to go to. While declining to give a pledge that there will not be any alteration in the plans, the Chairman said there will not be any great radical change. Neither has anything absolute and definite been decided as to the charge for space. Nothing more than is likely to bring in an ordinary fair return will be asked; but, of course, as Mr. Helps pointed out, no one is likely to embark on a big undertaking of this kind without fair and reasonable expectations. It was remarked by Mr. Bridges that no expense must be spared to make the exhibition a success from the exhibitors' point of view, by providing entertainments, music, and so forth; and this will be a costly matter. Considering that the exhibition is to last a month, he does not regard prices ranging from 3s. to 4s. as unreasonable. Mr. Bridges also showed that he had in mind a very comprehensive scheme for advertising the exhibition. Further, that, although the nominal charge for entrance is to be 1s., exhibitors are to have special facilities in this direction by having packets of tickets at 3s. a dozen. Arrangements have also been made to sell cheap tickets to gas companies and committees for distribution among consumers and friends. Mr. Blakey, of the Compressed Gas Company, urged that provision should be made for ensuring the visit to the exhibition of directors, committee-men, and managers; and the Chairman assured him that steps are being taken to bring together the *élite* of the industry.

Mr. Terrey, of the Imperial Stove Company, advocated diplomas for exhibitors; but Mr. Clare stated that he is rather doubtful about them, and would rather there were not any. With this view Mr. Thornton associated himself; and Mr. Marsh saw in them a source of bickering and uneasiness. This appeared to be the general view; and the Chairman announced that the Committee have already determined not to offer diplomas as they are usually understood. They do, however, contemplate offering prizes for such objects as may hereafter appear to be advisable, and perhaps some diploma for special co-operation. It was suggested by Mr. H. Hoare (of Messrs. Ashmore, Benson, Pease, and Co.) that prominent attention should be given to ventilation.

A question was raised by Mr. C. D. Holmes as to whether it was proposed to demonstrate the manufacture of gas at Earl's Court, which is a suggestion that was made in the "JOURNAL" in connection with the Crystal Palace Gas Exhibition of last year. It appeared from Mr. Helps's reply that it would be a big undertaking to put down works for the supply of the whole of the buildings and exhibition; but, he said, if the manufacturers of plant will combine to put down a working model gas-works, the Committee will give them every facility.

The matter of the formation of a Manufacturers' Committee to assist the Advisory Committee was next discussed; and a large number of those present gave in their names. It is intended that other manufacturers who desire may join this General Committee; and from it a Working Committee will be appointed.

The discussion closed with the passing of a resolution, moved by Mr. Clare, and seconded by Mr. Terrey—"That this meeting, having heard the statement made with regard to the forthcoming International Gas Exhibition, promises to support the project, and to encourage and assist it in every possible way."

THE INSTITUTION OF GAS ENGINEERS.

PROCEEDINGS AT THE SECOND ANNUAL GENERAL MEETING

HELD AT THE

INSTITUTION OF MECHANICAL ENGINEERS, WESTMINSTER, S.W.,

JUNE 7, 8, and 9, 1904.

MR. H. E. JONES, M.INST.C.E., PRESIDENT, IN THE CHAIR.

REVIEW OF PROCEEDINGS.

BRILLIANT weather favoured this year's meeting of the Institution, and there was an exceptionally good attendance of the members in the Hall of the Mechanical Engineers, Storey's Gate, not only on the opening day, but likewise throughout the whole time of the meeting. From the warmth of the reception accorded to the President, Mr. H. E. Jones, on his taking the chair, it was to be inferred that the accession to this office of so distinguished a leader of the profession was well regarded; and the President's first words placed him on the best of terms with the whole assembly. The formalities attending the commencement of the business of a meeting of the Institution were curtailed this year; the absence of the usual presentation of awards for the previous year's papers being specially noticeable. Happily, as evidenced in the report of the Committee, this function will be restored with added splendour next year. The President's references to the losses sustained by the Institution through death were particularly sympathetic and well suited to the occasion. There is much to be said in favour of the view expressed by Mr. Carr with respect to this mournful topic—that the memorials of the Institution's honoured dead should be more fully recorded in its archives than has hitherto been the practice.

Criticism of a presidential address delivered before a national society of gas engineers is never an easy or a grateful task, because the main interest of the composition is personal, and it is therefore difficult and invidious to separate the speaker from his discourse. A presidential address is the nearest thing to preaching which an unclerical person ever has to do; and everbody knows how much the sermon owes to, or suffers from, the preacher. In the present instance, the address bears ample indication of being the composition of a fully occupied man. In respect to its length, it irresistibly recalls the classical anecdote of the writer of a long letter who explained that he had not had time to write a short one. Having said this, however, of the address of Mr. Jones, let it be further remarked that there are passages in it which show the author's gift of style when he has the chance of exercising it. Thus, the opening paragraph, in which the President makes the customary formal acknowledgment of the honour of the office, is really eloquent. The explanation of this distinction of style in what is usually only a piece of formality is probably that the lines were often turned over in the President's mind, and obtained their polish in the process. Proceeding forthwith to lay out the framing of his address, just as a builder of a gasholder tank fits up his trammel, Mr. Jones invited consideration of such gas-works as those on the sea-shore at Portslade, and on the East Greenwich marshes; upon which text he constructed his exercise descriptive of the responsibilities of the gas engineer. In connection with this part of the subject, it is to be noted that the President made his first point—that the engineering of small gas-works is nowadays quite a complicated business, requiring from those responsible for it a very wide knowledge of mechanics. This observation is just, and well worth bearing in mind. It is impossible to read any of the older books about gas manufacture without being reminded, by the incidental statements and omissions of the writers, that gas making in a small way many years ago was a very simple and rough business. Great differences existed in those days between what was tolerated in small works as compared with the larger establishments. In contemporary practice, no such difference can be detected where the working is modernized—except that perhaps the smaller works are better than the larger, in which responsibility is more divided.

It is possible to pile up a formidable-looking list of the qualifications of the perfect gas manager and engineer; and Mr. Jones does it, referring more than once to the many and various branches of a scientific and mercantile training in which aspirants for the care of gas undertakings should be exercised. He declares finally that of all preparations for responsible employment in the executive department of gas undertakings, that by way of mechanical engineering is quite the best; and it is possible to agree with him on the point. Civil and mechanical engineering together are the best gate by which to enter a gas-works. But the chief reason for this is not stated by Mr. Jones. Really, it is not merely because the arts of mechanics and construction are of the first importance to the manager of gas-works, which are full of machinery, and always being rebuilt and enlarged, but also because this training is carried on in works and on outdoor jobs. Therefore, the young engineer acquires, together with the ability to use tools, a first-hand knowledge of men, materials, and the world, which are of more use to his after-life than all the academical distinctions of the college-trained chemist or the aptitude of the accountant. Besides this, a young man who has kept himself straight in the workaday world, not forgetting his studies the while, is usually stronger in every sense of the term than a mere clerk or collegian. To say that the successful management of a modern gas undertaking means, besides the ability to apply science to practical uses, a good knowledge of business, is only to say in other words that gas management, like railway management, nowadays covers a wide field of industry and trade. Of course, it ought to be better paid; but the only practical course by which the rising generation of gas managers can themselves improve the standing of their employment is by improving themselves. Already a good deal has been done in this way; and it is now commonly observed that while both the highest and the lowest posts in the service are not well paid, there is a far greater number than formerly of medium offices carrying sufficient remuneration to enable the occupant to live in fair comfort. Having regard to the general raising of the standard of education during recent years, it cannot be contended that the amount of special training suggested as requisite for the attainment of such a position is excessive.

A good deal of the address was devoted to the consideration of the subject of power and fuel gas supplies, with many incidental references to the economical problems of distribution. Clearly, distribution is of the essence of this matter. With it is inextricably bound up the question of which is the best value, in the form of combustible gas, for money. The President drew attention to the heavy burden of capital expenditure which oppresses most gas undertakings, and helps to raise the selling price of the product against the consumer. It is rather a pity that he did not take the opportunity for pointing out that producer-gas plant is no cheaper than carbonizing plant—thus forbidding any hope that the public could expect to be better served by the former. There may exist somewhere in the public mind a suspicion that the established gas undertakings are an obstacle to the provision of cheap fuel gas supplies; but this is not the case. The only possible means of cheapening gas to the public is by way of an augmented consumption; just as the way to increase consumption is to reduce the price. This is a circular argument; but there is no other equally pertinent to the issue. The chief difficulty lies in entering upon the circle. Usually, as Mr. Jones incidentally admitted, in the case of an old-established undertaking this innovation can only be

accomplished by making a decided reduction in price on sales for a particular class of consumption. This is now customarily done in the case of gas-engine supplies, for several good and sufficient reasons. The President very warmly applauded this practice—justly celebrating Malton (Yorks) as a brilliant example of enterprise in this regard. There may be held to be some little confusion in the presidential illustrations of the effects of prepayment meter supplies on the desirable development of gas consumption per unit of capital employed and per mile of distributing main. Prepayment supplies increase capital, while they increase consumption as a whole. It would have been instructive if the President had cleared this matter up. The case for assisted gas power supplies is on a totally different footing from that presented by the prepayment meter branch; and it is doubtful whether the latter really tends to reduce the cost of carrying on the business. That it is expedient to have such a popular branch is generally agreed; but the question is whether it is not largely as a point of the duty of the undertaking to the poorer order of the community, not as a source of profit. One aspect of this question was touched upon in the course of the President's references to the subject of rating.

It is almost needless to remark that the President's view was throughout in favour of gas of low illuminating power. It was roundly asserted that no reason exists "why coal which produces 10,000 cubic feet of 15-candle gas should not produce 15,000 cubic feet of 10-candle gas." This is a hasty conclusion. As well might one remark that a hen which can lay 10 eggs in 15 days ought to be able to lay 15 eggs in 10 days. The answer to both propositions is the same: There may be no known reason against the performance; but it has never yet been done. It will be time enough to discuss the economics of such a style of gas production when it happens. To tell the truth, the President's treatment of this problem was sketchy and not very helpful. Professor Lewes's prescription for 12-candle gas we know; but 10-candle coal gas made pure, not by the aid of an overworked exhauster, has never yet been seen in the market. Whenever it appears, it will doubtless be the outcome of perseverance in experimenting on the works as well as on the laboratory scale, in the direction indicated in the address—*i.e.*, by abandoning all thought of enrichment, and treating coal with untrammelled liberty to get the utmost value out of it in the form of gas.

The President naturally referred to the latest tendencies of gas legislation; and to the Board of Trade Committee on the Testing of London Gas. Perhaps as useful a portion of the address as any came near the end, where the subject of gas-works assessment and rating was dealt with in a highly suggestive style. Here, as already observed, the prepayment meter branch of gas companies' business came in for examination in a new light, with some instructive results. The President's reflection on the unhappy effect, as regards rating, of excessive capital well deserves to be written up conspicuous in some board-rooms, where the pernicious practice is followed of sparing the revenue account the proper charge for renewals. It is difficult, even to the verge of impossibility, to suggest means for curing this bad propensity of directors, particularly as improvident habits of this kind are calculated to be transiently popular under the sliding-scale. The easy colloquial tone natural to the President materially enhanced the interest of the matter of the address, by enduing it throughout with the personal "note" which weighs so much in such cases. The leading ideas through the address—the praise of cheap gas of low illuminating power, and the paramount obligation resting upon gas engineers to dignify their calling and keep the control of works design in their own hands—were thus expounded with all the force of ripened judgment.

The first paper taken was that by Mr. Colson, of Leicester, which may be epitomized as setting forth the advantage of half-measure in the installation of a prepayment meter system. This arrangement appears to answer well in the case of Leicester, for some reason which was not given. The discussion following the paper was long and of considerable practical value; most of the speakers owning to being "whole-hoggers" in regard to the provision of internal fittings, and there being a consensus of opinion that this cannot be done without loss under the present customary excess charge of 10d. per 1000 cubic feet. One of the most pointed contributions to this discussion was that of the President-Elect, Mr. Irving—a circumstance which furnishes good promise that the technical interest of the proceedings of the Institution during his year of office will be well sustained. Mr. Terrace, of Middlesbrough, followed with his paper on the gasholder tank troubles at this place, which proved to be a highly creditable statement of measures taken to deal with the difficulties presented by a marshy site. There was no discussion upon it; and the first day's meeting ended at two o'clock.

On Wednesday morning, the first business transacted was with regard to the Benevolent Fund, on behalf of which a strong appeal was made by the President. The advantage of holding this meeting before the resumption of the ordinary proceedings was demonstrated by the good attendance, from which it is to be hoped the funds of the charity will reap due benefit. The lecture, by Professor Harold B. Dixon, which followed, will long be remembered by all those who were fortunate enough to be present. It fully justified the high expectations formed of it; and will enhance the high reputation of the lecturer. The demonstration with which it concluded, of the brilliant effect producible by converting a Welsbach mantle into an oxy-coal-gas light, was very effective. Dr. Colman's paper which followed was an able exposition of the part played by "tar fog" in connection with the office of gas condensers; and it served well to bring before the Institution the additional piece of apparatus—the conical separator—which the author has successfully introduced with the object of removing this form of impurity. The number of new parts of gas-works plant which have been added to the gas manager's equipment is not so large that any instance of the kind can well be overlooked; and Colman's Separator will do much to keep the name of its sponsor green in the gas industry of the future. The discussion which followed the paper scarcely touched its subject, but was as discursive as all talks round about naphthalene invariably become when gas managers meet together. It was distinguished, however, by a memorable speech by Mr. A. F. Browne—one of the best efforts of one of the best speakers in the profession. Mr. J. Ferguson Bell's paper introducing the De Brouwer-Jenkins retort-working machinery at Derby was the most considerable technical communication to the meeting. The whole business of carbonizing practice is in a state of suspense just now. One would only interject the observation that in the survey of new plant it is not an admirable attitude to adopt, that the whole thing must be perfect and "fool-proof." A certain modicum of intelligent use must be assumed; and the degree of this essential is steadily rising.

It would be difficult to exaggerate the importance of Professor Unwin's paper; and the Institution is also indebted to Mr. Humphrey for his kind help in explaining the merits of the Ferguson pipe, for gas-mains. It is impossible to deal shortly with Professor Unwin's subject-matter in such a notice as this; and we shall reserve all criticism of his results for a more convenient occasion. The discussion was on practical lines; Mr. T. Goulden taking the opportunity of explaining the gas transmitting and distributing practice of the Gaslight and Coke Company. Mr. A. E. Broadberry's paper proved to be a thoughtful consideration of the uses to which the public roads can now be put by the various claimants to the franchise of the subsoil and the surface, with mutual respect for one another's rights. It was an excellent little treatise on the subject, calculated to be of distinct use in regard to a very troublesome line of practice. The last paper, by Mr. W. Sugg, was quite in the familiar manner of this master of the art and practice of gas lighting; and this is adequate praise. With these three papers and the necessary formalities for concluding the business of the meeting, the whole of Thursday was well occupied; the attendance being remarkably good to the very close. In the course of his speech in moving the vote of thanks to the President, Sir George Livesey gave an extraordinary turn to the proceedings by vigorously discussing what was supposed to be the finding of the Board of Trade Committee on Gas Testing. He was followed in this distinctly irregular performance by the President himself, who got a vote from the meeting in favour of protesting against something which the Committee were believed, only on the strength of an unauthorized statement, to have done. This subject had better be treated in the regular course, on the official report; and therefore our own comments upon it must be sought elsewhere. It only remains to acknowledge the great success of the President's reception and dance at the Hotel Cecil on Wednesday night; and the good attendance at the excursion to Arundel on Friday.

A SKETCH OF THE PROCEEDINGS.

(For Full Report see p. 741.)

COMPLACENCY with everything and everybody was the general demeanour of the assembly of members of the Institution of Gas Engineers who filled the seating accommodation of the lecture theatre of the Mechanical Engineers when the President, Mr. H. E. Jones, took the chair shortly after 10.30 on Tuesday morning. Several members of the Council were with him, including the Vice-President (Mr. D. Irving), and the Hon. Secretary (Mr. James W. Helps), together with the Secretary, Mr. Walter T. Dunn. The large gathering confronting the presidential daïs bore witness to the popularity of the President in other engineering circles than the one in which he particularly practises. His activity as a member of the Great George Street Institution has made him many professional friends; and some of those whom one is accustomed only to see at the meetings of that august body were present to honour their colleague in the position he held for the time being as supreme head of the gas industry's chief organization.

On the Annual Report.

The greeting which the President had on rising to open the proceedings was of the kind that assists to brace up a man filling a temporary position of unusual responsibility. The minutes of the last annual meeting were smartly disposed of by being taken as read, on the proposition of the President, seconded by Mr. H. Townsend. Then came the annual report, which was published practically in full in the issue of the "JOURNAL" for the 24th ult. The net increase of 31 in membership was received with much gratification; but there was the solemn silence of men face to face with some great, common bereavement when the long list of names was read of those professional companions who have "crossed the bar" during the interval since the members were previously assembled in the same room, and when several of those who are no more were then present, and taking an active interest in the proceedings. The references to the work of the Council in its many directions created the liveliest appreciation—particularly in respect of affiliation; and the concluding announcement as to the future award of medals for papers, and as to the generous responsibility the President has taken upon himself, for a period of seven years, of supplying the gold medal (which will be known as the London Medal) for the best contribution, was received in a manner which showed that the whole meeting endorsed the change from what was formerly customary in connection with the old Institute. The various matters dealt with by the report were the subject of comment by the President in moving its adoption. An allusion to the further distinction that has been conferred by the King upon Sir George Livesey in appointing him a Royal Commissioner of the St. Louis Exhibition was hailed with a generous and sincere outburst of applause. Then all expression of happiness was again abated, as the President passed to "the loss that death has dealt to our ranks." He particularly touched upon the lives and work of Alderman John Annan, Mr. Thomas Fletcher, and Mr. William Foulis. No higher tribute could have been paid to an engineer than was paid by the President to his departed friend Mr. Foulis. "He was in every sense an ideal gas engineer; he had the attributes of a kindly and genial gentleman; he had a thoroughly scientific grounding, education, and training; and his works remain behind him to show the great service he rendered to the community of Glasgow." The loss to science and industry of Frederick Siemens, who was one of the first to receive the distinction of the Birmingham Medal, was remarked upon; and his enormously beneficial work in connection with gas firing was recognized in phrase befitting so great an achievement. In connection with the subject of affiliation, it was stated (amid the best possible expression of gratification) that four Associations have pledged themselves in general meeting to the scheme; and a fifth—the Southern—is almost as good as in the ranks of the Institution. The President is certain that it is only a matter of time when all the Associations will fall into line. On the subject of the International Gas Exhibition, he assured the members that it will be a thorough success. The adoption of the report was readily seconded by Mr. Isaac Carr, who carried the meeting with him when he stated his appreciation of the remarks the President had made with regard to the loss the Institution had sustained by the death of Mr. Foulis and Mr. Fletcher, because he felt the reference in the report was an insufficient record on the part of the Council of gentlemen who had rendered such life long and eminent service to the gas industry.

The President's Address.

This brought the members to the item of capital importance in the programme for the opening sitting—that was, the President's address. It was published last week, and its subject-matter is reviewed in foregoing columns, so that further allusion is not needed in this general outline of the proceedings. Long as the address was, its diversity of matter, and the characteristic diction and delivery, with an interspersion of spontaneous witticisms here and there, kept interest from tiring, and the members were almost inclined to rebel against the occasional Presidential omissions of prepared matter. It was no mere compliment that Mr. Joseph Hepworth paid to the President when, at the conclusion of the deliverance, he said that no address had interested him so much as had the address to which the members had just listened. It bristled with interest, and, to Mr. Hepworth, particularly so in those parts dealing with the education of the engineer. The motion which he moved was seconded by Mr. R. O. Paterson, who asserted that he had never heard an address displaying such an accumulation of knowledge and experience. There was no uncertainty as to the unanimity of the members in subscribing both to the motion and to the remarks of the proposer and seconder. In his thanks, the President described the address as "a conscientious message at the end of 42 years of hard working life in your own ranks." The greater freedom which he now enjoys is, however, saddled with one drawback—that it divorces him from the work and workfellows that he loved to be among. Another of his notable remarks worth remembering is this, that a man who has knowledge of some little fact from his own observation is stronger to speak on it than the man in his office at Westminster.

Ten Years' Experience with Prepayment Meters.

To Mr. Alfred Colson fell the honour of presenting the first contribution for discussion. It was of an administrative rather than of a technical character, dealing as it did with the experiences of Leicester in the matter of prepayment meters. A salient feature of the communication is that, without the provision of fittings, but with the free fixing of cookers, the system has done remarkably well. It was in 1894 that prepayment meters were introduced into Leicester, and 344 were fixed. In the same year, there were 25,819 ordinary meters in use. When, however, the paper was written, there were in use 25,451 ordinary meters, and no less than 26,639 prepayment ones. To the free fixing of cooking-stoves and the systematic canvassing of non-consumers, this very rapid increase is attributable. Of the 26,068 slot consumers at the end of 1903, 25,318 had free cookers. The importance of making a careful selection of slot meters, as bearing upon accurate working and costs of repairs and maintenance, is impressed by some instructive figures in the paper; and the question of inspection and collection receives full attention. It appears that the ordinary price of gas in Leicester is 2s. 4d. per 1000 cubic feet; and the rate for the prepayment consumers is 30 cubic feet per 1d., which is equal to 2s. $9\frac{1}{8}$d. per 1000 cubic feet. The tables in the paper are well worth particular study. In 1898 1024 cooking-stoves were fixed free in connection with slot meters; and in that year, the number of prepayment consumers was 8640, the consumption 79,525,400 cubic feet, and the average consumption 11,409 cubic feet. The growth of consumers and consumption was at a fast rate after the adoption of the free-cooker policy; and last year with 26,068 slot consumers and 25,318 cookers, the total prepaid consumption was 402,178,800 cubic feet, or an average of 16,137 per meter. The percentage of the total gas consumption represented by prepayment consumption has grown since 1898 from 5·5 to 22. There are many more interesting figures, not the least among them being the table which shows, item by item, the extra cost of the prepayment consumers per annum. The total extra cost of each

prepayment consumer works out to 7s. 10·70d. per annum, or 5·91d. per 1000 cubic feet. The extra price of 5·33d. per 1000 cubic feet represents, on the average consumption, 7s. 1·28d. per consumer, which shows a loss of 9·42d. per consumer, or 0·58d. per 1000 cubic feet. Against this, Mr. Colson sets gains, which "must certainly be more than sufficient to cover the loss." He emphasizes the point that the 5·33d. per 1000 cubic feet should not be taken as sufficient to cover all additional costs in other towns.

Throughout the discussion, there was praise to the author for the manner in which he had presented the statistics of which his paper was so largely composed. The point that particularly interested Mr. George Helps was that Mr. Colson did not supply fittings, which in his (the speaker's) view have been the cause of all the trouble in connection with the slot-meter system. With an average consumption of 16,000 cubic feet per annum, and an extra price of 5⅓d. for meter and cooker only, it appears to Mr. Helps that it is impossible to go wrong. The paper showed in every passage that the system is an undoubted success at Leicester; and he stated his opinion that it is more likely to stop the wild introduction of fittings than any other contribution to the subject he has ever heard. From Mr. C. S. Ellery it was learnt that at Bath between 13,000 and 14,000 cubic feet is the consumption per slot consumer; and he has gone in there for the "wild system" of fittings as well as stoves. It was elicited by Mr. Ellery that at Leicester 5-light slot meters have been adopted; but at Bath the system was embarked upon with 3-light ones. His experience suggests that those who are going in for the system should look well into the question as to whether it is not advisable to adopt a larger size than the 3-lights. Mr. Ellery also brought to light the fact that Mr. Colson does not charge rent for furnishing ordinary meters. Where meter, stove, pipes, and fittings are being supplied, in his (Mr. Ellery's) view nothing less than 10d. per 1000 cubic feet can be charged; and further, in his opinion, 10 per cent. is rather a low figure to cover interest and depreciation on cookers. The question as to the effect that the slot-meter system has, or may have, upon the expenditure on the distribution system is another point that Mr. Ellery says must not be neglected; he illustrating this by a district a few miles from the Bath Gas-Works that has required the laying of larger mains entirely through the slot meter. Study of the Leicester gas accounts over some years has shown Mr. D. Irving that the distribution costs have been steadily on the increase, ever since slot meters were introduced—in fact, the increased cost during the last ten years amounts to above 2d. per 1000 cubic feet on the whole of the gas sold. In his judgment, too, it is rather a reflection on the municipal administration of the Leicester gas undertaking that the magnificent extension of business brought about by the slot meter has not resulted in some saving to the gas consumer; for the price of gas there is now practically the same as ten years ago. Criticism of some of the items of cost was made by Mr. W. W. Topley, Secretary of the Croydon Gas Company. He put his finger on the item "differences, including thefts" 2·52d. per consumer as showing a weak point in the slot system; and he sees in it a little inducement to collectors to make small manipulations. He much prefers the system at Croydon—the stop meter—by which loss and all this kind of thing are avoided. No provision, so far as he could ascertain, was made for the capital expenditure involved by the cookers. These are a few among the items that claimed his attention. He also asked generally for the reasons which have induced the authorities at Leicester not to supply fittings. In Burnley, the members heard that Mr. J. P. Leather is in the happy position of not having to supply gas-fittings, because all the houses there were furnished with their own fittings when built. Perhaps there were not more than 150 houses out of 20,000 in the town that had not services in when the prepayment system was started. Therefore, services and fittings are not supplied free. A small boiler and griller are furnished; and 6⅓d. is the difference charged above the ordinary price of gas. Costs work out to a little under 6d. per 1000 cubic feet. An agreement is entered into with the consumers by which they pay any money short of the registration of the meters. Experience at Waltham Cross has convinced Mr. W. B. Randall that 10 per cent. on the cooking-stoves is insufficient; and he regards 20 to 25 per cent. for depreciation and interest on the stove as a better working figure. He finds that the working costs for the prepayment system are at least three to one for the ordinary system. The extra charge in the case of Newport (Mon.), Mr. Canning states, is 8d. per 1000 cubic feet; and rather than increase the charge to the prepayment consumer by another 2d., he would put it on to the ordinary consumer, which is a proposition for which surely no just defence can be made. Seven-twelfths of the consumers in the town are on the slot system; but without it is adopted in its entirety, with a cooker, it is, in Mr. Canning's opinion, no use having it. He puts a request, in large type, on every meter asking the consumer to give notice when leaving the house; and, in nine cases out of ten, they do this. He objects to the fixing of a minimum consumption for a prepayment consumer; and he prefers, in the case of very low consumptions, to give notice that the meter will be taken away if the consumption does not improve. Mr. Lees considers that the difference between 5⅓d. and 10d. would fully compensate for the cost of the fittings. As to the depreciation of cookers, the amount set aside all depends upon the class of cooker adopted—if the cooker is a poor unpacked one, the depreciation would be greater than for one packed all round. On the point of fixing a minimum, he is in agreement with Mr. Canning; and, further, without a cooker, he holds that the slot system is not what can be termed really successful. A few questions were put by another member, after which Mr. J. H. Brearley made the point that, if the cookers at Leicester are unpacked ones, he is not surprised at the consumption increasing so rapidly. Unpacked cookers are expensive for the consumers. That the slot consumers assist in lessening the standing charges per 1000 cubic feet of gas sold, was among the points raised by Mr. R. Watson, who has also found that, instead of increasing the cost of mains, the slot consumers at Doncaster have all been served from the old mains, and so had helped to largely spread the charges for the old capital expenditure.

The reply of Mr. Colson was somewhat shortened owing to the flight of the time allocated to the morning sitting. On the question of fittings, he is at one with Mr. George Helps. The maximum amount of benefit for the minimum amount of drawbacks is the reason why Leicester decided to supply a cooker and only a short length of pipe with the slot meter, without other fittings. Agreeing that the slot-meter system requires considerably more attention than the ordinary, still he finds the extra price is ample to cover all such charges. He also asserts that 10 per cent. is sufficient for the upkeep of the cooker where care is exercised in its selection. Both unpacked and packed cookers are used at Leicester. The increase in the distribution cost, it seems, arises, not from the prepayment system, but from the prosperity of the gas undertaking allowing a good deal more than formerly to be charged to revenue that might very properly have gone to capital. As to the risk attaching to the system, if thoroughly trustworthy men are employed in connection with it, the same success that is met with at Leicester can, Mr. Colson believes, be obtained elsewhere. It was a long discussion; and, at its close, Mr. Colson was most heartily thanked.

Gasholder Tanks on Marsh Lands.

The unhappy experiences of the Middlesbrough Corporation with gasholder tanks constructed on the marshes site supplied the subject for the second paper, which Mr. David Terrace contributed. The particular form of trouble appears to have started some 30 years ago. The first gasholder tank was 182 feet diameter by 35 feet; and for this drawings and specifications were prepared by the Gas Engineer. The Contractor for the work had not any previous experience of tank construction; and, after about two years' operations, the partly completed tank-wall suddenly collapsed. It seems there had been no supervision over the Contractor; a concrete bed which was to form the base of the tank wall was altogether omitted; and the wall was only 3 ft. thick, instead of 4 ft. 3 in. On the recommendation of the Engineers consulted, a new tank of smaller diameter was constructed within the one that had collapsed. It stood filled with water for two years before the erection of the holder; and, when emptied for this purpose, the sides were found to be cracked. The cracks were repaired, and the tank has now stood tight for twenty years. The next holder constructed had a steel tank, 185 feet diameter, standing on a bed of concrete 3 feet thick. It was decided to guide this holder on the wire-rope system; and the advisability of this has since been proved. Two years after, the difference in level was 8 inches; and attention was called to the comparative rapidity with which one side of the tank was sinking.

Mr. Terrace thereupon suggested the principle of lowering, if possible, the high side of the tank by trenching round it. No action, however, was taken. Three or four years later, the difference in level was 13¾ inches; and, the holder then being in danger when cupping and uncupping, the author was entrusted with the task of preserving the tank and holder. Owing to the character of the strata, he made a perforated trench, composed of about 150 boreholes, 16 inches in diameter, 30 to 50 feet deep. The weight of the tank bearing hard on the edge near these borings squeezed the soft clay into them; and thus a lower level was reached by the tank on that side. After twelve months' work, the sinking action was reversed; and the tank is slowly reaching a comparatively stable position. The financial aspect of these experiences are also dealt with by Mr. Terrace.

Time did not permit of the paper being discussed. But, before separating, the President remarked upon the want of supervision in the original construction of the tank, and upon too much faith having been put in the 3 feet bed of concrete in the second tank. He concluded by congratulating Mr. Terrace upon the skill and ability he had shown in making the perforations, and so encouraging the tank to sink in a somewhat less capricious manner than formerly.

The Benevolent Fund.

Very properly this fund took precedence of all other business on Wednesday morning; but, it is a strange thing that, no matter when the affairs of the fund are to be brought before the members, there is never such a large muster as at other times, though there is now an improvement on former experience. The report of the Committee of Management (printed in the "JOURNAL" for the 24th ult.) was read by Mr. Dunn; and the adoption of both it and the accounts was moved by the President. Out of the total of 715 members of the Institution, there are only 97 contributors; and the President made a very stirring appeal for a voluntary broadening of the basis from which subscriptions are drawn. A worthy seconder was found in Mr. John West. With the best of intentions no doubt, Mr. T. Duxbury made a suggestion by which the Benevolent Fund would benefit, but which, after a little deliberation, he himself must have seen was a mistake. There were, he pointed out, some 125 to 130 names of gentlemen appearing in the lists of the Gas Institute two years ago who were not qualified for membership according to the new rules. He suggested that their names should be printed at the end of the list of members; and that they should have the privilege of attending the meetings, without any other active rights. These gentlemen, he was sure, would be willing to subscribe their one to five guineas to the fund. Mr. W. W. Hutchinson endorsed the suggestion. The President's comment was that he could not conceive of any shabbier treatment of a gentleman than to try to stimulate his charitable feelings towards the weaker or more unfortunate members of the Institution at a time when he was not himself a member. The President was certain such a proposal would not go down with the very gentlemen to whom Mr. Duxbury had referred. A further intimation was that the Secretary had been instructed not to refuse a contribution from any source whatever; but he was not to solicit or suggest one from outside the ranks of the Institution.

The Mechanism of Combustion.

Members flocked in after the affairs of the Benevolent Fund had been disposed of, in order to hear Professor Harold B. Dixon deliver his lecture on "The Mechanism of Combustion." One might almost have imagined he was with the Professor in his own lecture room at Owens College, Manchester, for in front of him were arranged all the chemical paraphernalia necessary to experimentally illustrate different stages of the lecture—for showing the characteristics of flames constituted of different gases mixed, for separating inner cones from the outer of bunsen flames by Smithells' beautiful and ingenious method, and for demonstrating the rate of explosion of gases, which subject the lecturer has made so much his own, and which he further illustrated by lantern views of photographic analyses of explosion flames. Professor Dixon was in excellent form, and though he occupied a goodly portion of the morning, his large, attentive, and appreciative audience would have asked for more could they have found it within their consciences to have done so. The scheme of the lecture so interlaces one part with another that to outline it would afford no useful information; and therefore readers must peruse the full text published in other columns to obtain complete knowledge of this most valuable and "luminous" contribution to the proceedings. The lecture, it will be seen, covers historical as well as modern work in this fascinating field of investigation. Right away from the seventeenth century, surprises, as the result of scientific experimental work on flame, have been many. Yet Professor Dixon believes that the future may be even richer than the past in surprises; the subject being intricate and difficult to the last degree. Indeed, great and extensive as has been the labour bestowed upon it, he describes the subject to-day as "a tangle whose outer fringe we are only now beginning to unravel." This is the justification for not attempting to reduce the lecture to a shorter compass than that in which the Professor presented it. But having dealt so fully with the phenomena of explosions, he drew from it, in his final words, a practical lesson for practical men. If, he pointed out, an explosive mixture is made that will give a luminous flame (as had been so impressively shown by photographs), a far greater brilliancy is attained. Would it not therefore be better, he asked, to mix oxygen with the coal gas, and get a mixture which would really give an explosive flame? Industrial (50 to 60 per cent.) oxygen can now be made fairly cheaply by the fractional distillation of liquid air. It has been made on the large scale at a cost of about 5s. per 1000 cubic feet; and he sees no reason why it should not be made for half this price. Coal gas fed with oxygen can be made to burn with a mantle, and give roughly a light of 200 candles for a consumption per hour of 2 cubic feet of coal gas. He showed the experiment with a small incandescent burner and mantle. The light was intense; and the numerous electric incandescent lights in the hall paled before it. This, he said in his concluding words, would have been thought chimerical a year or two ago; and yet it is only one of the developments which must flow from a study of the mechanism of the combustion of gases. There was prolonged applause at the close of the lecture, which was continued as the President rose to propose the passing to Professor Dixon of the heartiest thanks of the members. He specially referred to the last demonstration, and characterized it as a "great departure," if it be true that oxygen could be manufactured at 5s. per 1000 cubic feet, and could be practically applied to the incandescent gas-burner. The motion was very appropriately seconded by Dr. Colman, who is an old pupil of Professor Dixon; and, to carry the link with the gas industry farther back, it may be mentioned that the Professor claims Mr. A. G. Vernon Harcourt as his "old teacher."

Condensation of Illuminating Gas.

It was fitting, under the circumstances just alluded to, that Dr. Colman should next occupy the platform. He read a paper on the above subject; and both it and the discussion will be found of surpassing interest and value. He sketched the objects now aimed at in condensation as being the reduction of the hot gas to atmospheric temperature, at the same time retaining in the latter as much of the most volatile boiling constituents (mainly the benzene, toluene, and, to a much smaller extent, the three xylenes), as it can permanently carry at the lowest temperature to which it may be afterwards exposed, and also to effect the complete elimination of naphthalene and all other higher boiling substances. He proceeded to show that, under present-day conditions, the retention of these vapours has no longer anything like its former importance, as the effect of these on the calorific power of the gas is much less than on the illuminating power. But even now, simply from the calorific point of view, these vapours are more valuable in the gas than when left in the tar, provided that they can be retained at little or no expense, and that they are not deposited before the gas reaches the consumer. Having mentioned that it has long been recognized that the amount of the low-boiling hydrocarbons and naphthalene left in the gas depends upon the manner in which the tars first separated come in contact with the gas still containing the benzene, &c., in a state of vapour, the author of the paper deplored that there is still no general agreement as to the principles according to which the condensing system should be arranged, in order that the tars separating as the cooling proceeds shall be compelled to act on the gas to the best advantage. Here there is a problem, which cannot very well be solved on a manufacturing scale through the impossibility

of maintaining a constancy of conditions on a gas-works. Assistance, however, can be obtained from an industry in which fractional distillation is carried out; and as a specific example Dr. Colman took the preparation of pure benzene from the light oils obtained in the first distillation of coal tar. Throughout the devices employed, there is this one underlying principle, that the products which separate in the fractional condenser all flow backwards against the stream of ascending vapour. In this process, there is a marked similarity with the requirements in the condensation of illuminating gas. With illuminating gas, however, there are certain important conditions which are not present in the case taken as an example. In the first place, there is a large quantity of gas mixed with the vapours which is not liquefiable at the temperatures reached in the process of condensation; secondly, during the condensation of the hot gas, one of the vapours which liquefies is the steam, and the vapour formed does not mix with the liquid produced by the other vapours; and, thirdly, a very material difference in the case of illuminating gas is that, in the early stages of cooling, after the gas leaves the retort, the fall of temperature is exceedingly rapid, owing to the proportionately small number of heat units which have to be removed for a given lowering of temperature, and the great difference that exists between the temperature of the gas and that of the surrounding atmosphere. As a result of this rapid cooling, the heavier tars separate out as a dense fog of finely divided particles or vesicles. To all these points Dr. Colman gave extended consideration. But on the question of the tar fog, he went on to show that much depends. So long as it exists as a fog, it must inevitably travel in the same direction as the gas—being simply carried along mechanically with the latter; and, so long as this is present, it is impossible to carry out the counter-current system thoroughly. Dr. Colman showed, too, how the presence of the heavy tar fog in the condensers affects the removal of the naphthalene in two ways—one favourably and the other adversely; but he thinks it is probable that the influence of the tar fog is more adverse than favourable. This brought him to the discussion of the question as to how the fog can be cheaply and effectively removed from the gas as soon as possible. As the solid and liquid particles are so much heavier than the gas, it seems probable to him that they might be removed by centrifugal force; and a suitable apparatus was described. The separator introduced to the members is a larger form of a smaller one which, it will be seen, was described and illustrated some time since in the "JOURNAL." This larger separator has been put in at the Tottenham Gas-Works, and is capable of dealing with a million cubic feet of gas a day. Under the influence of the centrifugal force, the solid and liquid particles are driven to the circumference of the apparatus where they coalesce, and fall down the sides, and away by a syphon; while the gas, nearly or wholly freed from suspended matter, passes out from the centre. There is no doubt, he says, the tar fog is, by this meaus, effectively removed. The experiences at Tottenham will be found to be an extremely interesting part of the paper.

The discussion was long. There was a tendency to romp away into the unlimited field of naphthalene experiences; but upon this the President put a check. An interesting contribution was made by Mr. H. Townsend. After inclined retorts were put in at Wakefield, there was trouble with naphthalene in the district. A Pelouze and Audouin tar-separator was first set up in a warm place in the works. Then there was trouble in keeping the seal in the hydraulic; but tar towers were put in, and this difficulty was overcome. In addition, the plan of working the condensers at a high temperature was adopted. Since these alterations were made, there has not been a single complaint of naphthalene in the works or district. The condensers are of the slow-speed Körting-Cleland type, and there is a bottle-brush in each pipe, which causes a considerable amount of friction; so that a good deal of the heavy tar and tar fog is eliminated. Mr. Townsend finds the illuminating power is a little better than before. Contrary was the experience related by Mr. W. E. Price. When the temperature of his condenser increases, naphthalene appears. He is now trying the effect of the introduction of tar into the condenser—that is to say, the reintroduction at the inlet of the condenser of the tar collected at the outlet. A comparison was instituted between the experiences of the Vauxhall and Bankside works of the South Metropolitan Company by Mr. A. F. Browne; and the importance of his statement can only be gathered by reading the full report. Owing to the circumstances of the plant at Vauxhall (now soon to be replaced), the gas is carried through the plant, till it comes to a "Standard" washer, at a high temperature. After this, the deposition of naphthalene is of a remarkable character. At Bankside, the gas flows to the condenser at a temperature similar to that at Vauxhall; and it then passes a water-tube condenser through which large quantities of water are being pumped at the temperature of the day—the cold water flowing in the reverse direction to the gas. This is what may fairly be called drastic and sudden condensation. The illuminating and calorific powers of the gas at Bankside are a little higher than at Vauxhall. Following the introduction of this system at Bankside, naphthalene has disappeared from that station. Remarks by Mr. R. Bruce Anderson showed that he is not favourably impressed by the separator introduced by the author. Experience and reasons were given by Mr. T. Glover to show that he considers Dr. Colman is wrong in seeking to remove the heavy tar particles at an early stage, because, by so doing, he removes the oil which is a solvent for naphthalene away from its action on the naphthalene. With Mr. Glover, Mr. C. E. Botley is in agreement; and it is his view that, seeing the conditions of manufacture and temperature vary so much from time to time, if freedom from naphthalene is wanted, then some extraneous means of dealing with it must be adopted. The President related the experiences at Epsom, where the gas is run backwards and forwards in a long length of pipe on the retort-house wall; and for thirty years there has been no trouble with naphthalene there. He also confesses to having realized an immense advantage from the use of carburetted water gas. This gas, he finds, is fully saturated with oil: and there is always a little oil carried over by it that is unfixed. This gets into the system, and keeps "the whole thing clear of naphthalene." In his reply, Dr. Colman stated that he is a firm believer in tar fog, and he considers it is most valuable. But he shows that it all depends upon the nature of the fog as to whether or not it should be kept in the gas. He further elucidated points in the paper. Altogether the discussion, like the paper, will be found to furnish much matter for profitable study.

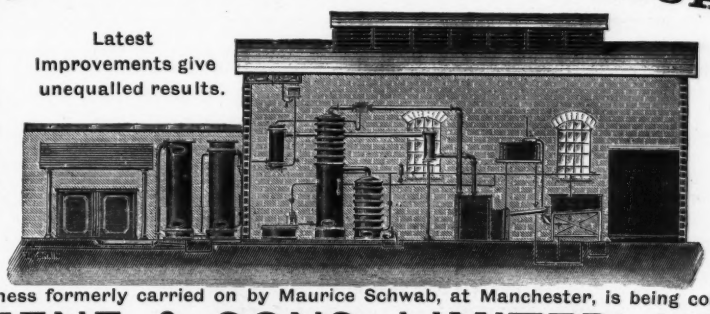
De Brouwer Machinery at Derby.

Before the sitting terminated, Mr. J. Ferguson Bell got through his paper on the De Brouwer charging machinery at Derby. Time was so limited, however, that he read part, omitted part, and scampered through the last few pages. This is a pity, seeing that this was the first occasion on which the De Brouwer machinery has been brought before a meeting of British gas engineers for criticism; and what made it worse was that, the sitting having been so long, several members had left for luncheon. The installation at Derby, so far as the projector and auxiliary plant are concerned, has been described in the "JOURNAL;" and therefore it need not occupy much space in this summary. In considering the paper, it must be borne in mind that the projector is capable of feeding a considerably larger number of retorts than it is now engaged upon at Derby. The details of the machine and other plant are set out completely; and the operation of charging is described. The charging of a retort 18 or 20 feet long is found by the Derby experience to occupy only from 20 to 25 seconds. For the first time, the De Brouwer discharger is described in this paper; but Mr. Bell wishes it to be understood that he has only had it at work a week, and not constantly. He finds that, by the use of the pusher, there is less breeze made than when employing a rake. The machine being new, those who are interested in it will look to the paper for the illustrated description. Owing to the circumstances of the house where it is used, the propelling and hoisting of the pusher are done by hand gear; but Mr. Bell is of opinion that, under suitable conditions, it would be better for the pusher to be motor propelled. However, the average time required to discharge one through retort, 18 feet long, is about 40 seconds from the starting of the pusher bar to enter the retort until the bar is again withdrawn and at rest. Next to the discharging-machine, the working results of the plant have the most refreshing interest; those published in the paper being the result of six months' continuous work on six beds of eight throughs. In the first place, there has not been any hitch or trouble of any kind; and the only renewal has been the broad band on the projector which

MAURICE SCHWAB, FORMERLY OF MANCHESTER.

Supply and Erection of Tar-Works, complete Bye-Products Recovery Plant, Ammonia and Acid Plant, Injectors, Acid Valves, Cocks, &c.

Latest Improvements give unequalled results.



SULPHATE OF AMMONIA APPARATUS OF THE MOST MODERN CONSTRUCTION. Solid Plate Lead, or Wood, lead-lined SATURATORS.

The Business formerly carried on by Maurice Schwab, at Manchester, is being continued by

H. GREENE & SONS, LIMITED, LONDON.

Under the Management of Mr. Schwab.

Telegraphic Address: "Owston, London." Telephone: 1693 Hop. Registered Offices: Surrey Engineering Works, Blackfriars Road, London, S.E

NEW PATENT GOVERNORS

DOWN CURRENT.

FOR Inverted AND Ordinary

INCANDESCENTS.

UP CURRENT.

BRUCE PEEBLES, LTD., EDINBURGH.

W. B. LAMPARD & Co.,

Gas and Cannel Coal Experts,

117-118, LEADENHALL STREET,

LONDON, E.C.

Telephone No. 1925 Avenue. Telegrams: "Lamparones, London."

GRAHAM'S PATENT
HOT COKE

CONVEYORS.

(PATENT No. 11,979—1900.)

COMPLETE
EXHAUSTION OF STEAM FROM
RETORT-HOUSE.

COMPLETE PLANT ERECTED BY US AT NANTERRE GAS-WORKS, PARIS, WILL BE INSPECTED BY THE MEMBERS OF THE FRENCH GAS SOCIETY ON JUNE 17TH.

SOLE MAKERS:

GRAHAM, MORTON, & CO.,
LEEDS.

carries the coal. The wearing of a belt is not, however, a serious matter. The charges are well put in, and perfectly level; and there has been an increase of some 300 or 400 cubic feet of gas per ton. The highest make per ton obtained with South Yorkshire small washed pea nuts has been 12,140 cubic feet of 16¼-candle gas—the average over three months, with Yorkshire and Derbyshire coal, being 11,316 cubic feet of 15·79-candle gas. The saving effected in carbonizing wages at the station in the six months was £455, which equals 42·74 per cent. upon the first cost of the installation. This represents a saving in wages of 11d. per ton of coal carbonized, part of which is due to the extra quantity of gas made per ton of coal, to the extra weight put into each retort, and generally to the alteration in the method of working. But ignoring these latter advantages, Mr. Bell shows in detailed tables that the saving effected, compared with hand charging and drawing, by the coal-handling plant and charging-machine is 8·6d. per ton—that is, with hand drawing. With his short experience of the "Jenkins De Brouwer" pusher, he finds the cost is reduced by a fraction—being 8·4d. per ton. Furnaces, clinkering, and attention to pipes represent 4d. per ton. It is calculated by Mr. Bell that, when a coke-handling plant is added, the cost of carbonizing will be reduced by a further 2·2d.; bringing the total down to 10·2d. per ton. The cost of the installation complete, including the coal-handling plant, was £1500, which at 15 per cent. equals £225, and makes the cost for interest, wear and tear, and depreciation, 3·4d. per ton. Many other interesting figures are given in the paper. In his concluding remarks, the author safeguards himself respecting the pusher by saying that, while, in the short time it has been at work, it has proved quite satisfactory, he prefers to have several months' experience with it before expressing a definite opinion.

The discussion on the paper (which opened the proceedings on Thursday morning) was an excellent one. It was commenced by Mr. John West—not of his own accord, but on the invitation of the President, who desired to know something about the new combined charging and drawing machine that Mr. West has put in at Wellingborough. Naturally this old pioneer in stoking machinery from good conscientious motives had some hesitation in complying; and he confined himself religiously to the Wellingborough plant. This is the "one man and one stroke" machine about which full information was given in an article in the "JOURNAL" for March 1 last, p. 572. Mr. West's remarks followed very closely the lines of that article. His statement that the whole cost of carbonizing, including every item from coal-waggon to coke-waggon, is about 6½d. per ton, gave considerable satisfaction. The question of regulating the charges had given Mr. Isaac Carr some doubt; but he understood from the paper that they could be regulated with the greatest nicety. If the discharging-machine proves as successful as the charger, the apparatus will, in his opinion, be a distinct step forward in the economical manufacture of gas. In regard to the old stoking machinery, he observed that it cannot be said in all cases to have been commercially justifiable. He has, in fact, refrained from stoking machinery, because he has not yet been able to see that any real economy would accrue from its introduction in his own case. Thirty years has been the length of the intimate experience of Mr. Alexander Wilson in stoking machinery—in fact, he had a hand in the trials with the old Ross (the American) machines. He foresees difficulty, when retorts become old and wrinkled with protuberances of carbon, in charging them with the De Brouwer or with any similar machine. Cheerfully, he remarked that those who have Arrol-Foulis or West machines need not be in the slightest alarmed that they will be superseded, for with them there is certainty of action. He is also confident that a pushing machine would not work with some of the coals used in the North. The charges, with the particular coals he had in mind, lay in the retorts like so much sand or nuts; and a ram would simply push such stuff into a heap in the retort. Mr. Tim Duxbury shared Mr. Wilson's impression that, when retorts became carboned up, there might be some difficulty with the charging by a projector. Fear was expressed by Mr. Canning that the charges would suffer by the regulation of the speed of the machine having to be left to a workman. The great thing that commended the De Brouwer machine to Mr. J. W. Helps on his first acquaintance with it was that it required practically no alteration of speed; while in the Paris machine there was a complication of mechanism that was not inconsiderable. However, from what Mr. Bell now said, it seemed to him that alteration of speed is necessary; and this, of course, introduces the personal equation. Mr. Bell has the discharging-machine on the opposite side of the bench to the charger; and Mr. Helps thought that advantage would accrue in the protection of the latter from smoke, steam, and dust, if both were put on the same side. He regards the De Brouwer machinery as particularly applicable to narrow retort-houses that are being converted. Information somewhat similar to that appearing in our account last week of the visit of the Midland Association to Nuneaton was furnished by Mr. George Helps as to the De Brouwer installation at his works. He finds that the belt can be regulated to any speed desired, and that nuts, beans, lumps, or dust can be used by it at will. He scored one off some previous speakers who feared that the projector would not work properly with old and carboned retorts, by saying that they ought not to have such retorts in use. Having seen the machine at work at Derby, Mr. S. Y. Shoubridge was struck with its simplicity. It was doing the work quite as quickly as two ponderous machines of the old type; and he saw in it the means of a great saving in first cost, in the expense of maintenance, and in working cost. The President does not think there will be the difficulty that Mr. Canning apprehends in connection with the man in charge of one of these machines. In his remarks, he also raised the question of the introduction of breeze into the charges of inclined retorts for the prevention of slipping. He derided the idea, and said it disintegrated the resulting coke. His observations on this point (as reported fully elsewhere) should be read by those concerned. He spoke, as he has frequently done before, of the simple stoking machines in use at Wandsworth; but he confesses that, if anything beats those machines, it is the De Brouwer. Mr. Carr was permitted one further remark. He understood that each time a retort is charged by the projector an air-blast passes through the retort, which had the effect of keeping it clean. This was confirmed by Mr. Bell. His retorts have been in use eight months, and have never been scurfed. From his experience, he was able to controvert the objections that had been raised. He explained that the reason he has put the projector and pusher on opposite sides of the bench is because the house is only 46 ft. 6 in. wide. Mr. Simmonds, of Bury, he added, has had one of the De Brouwer machines in use some six months; and he had written to him (Mr. Bell) to the effect that he is perfectly satisfied with it, and that his total carbonizing costs are 1s. 1d. per ton.

The Flow of Gas in Mains and Distribution at High Pressure.

A paper of rare technical value to gas engineers is that to which Professor Unwin next treated the members. It is a communication which he found some difficulty in reading, to useful purpose, complete to the members; and he therefore contented himself with explaining large portions of it. That which was a difficulty to the author is even more so to one desirous of giving an even more limited idea of its contents; and therefore it must not be assumed that this brief reference completely indicates the quality and character of the matter of which the paper is composed. There is the mass of formulæ which alone will constitute the contribution quite a standard work of reference in the future; and that must all go unnoticed here. Apart from this particular aspect of the paper, a general view of the other portions will show that they form an argument exhibiting the possibilities and the advantages for the transmission of gas in smaller mains at higher velocities than hitherto. It is surprising to Professor Unwin that a compound system of primary distributing mains at high pressure, delivering into secondary service systems at low pressure, seems not to have been considered until recently. Leakage he does not regard as a difficulty—at all events, it is such a difficulty as engineers should be able to overcome. Referring to the resistance to flow in mains, he pointed out that the small differences of pressure required in the present system of distribution are so well within command without alteration of apparatus, that gas engineers appear to rely on experience without troubling themselves with calculation. This led him on to a discussion of Dr. Pole's formula, which, although empirical, is, no doubt an approximately true expression for the resistance to the flow of gas in pipes in average circumstances. But

it undoubtedly requires modification in different cases. The succeeding part of the paper cannot well be condensed. Later on he discusses the co-efficient of friction; and here he showed how extremely desirable it is to have some exact experiments to determine this. It has, however, been established that the co-efficient of friction varies with the roughness and diameter of the pipes; being greater for small pipes and less for large pipes. The author here plots a number of values of the co-efficient of friction deduced from experiments on the flow of air and steam in long lengths of main; and presents for service, until some new experiments are made, an expression as giving the value of the co-efficient of friction in gas-mains. Next he proceeds to consider the question of the advantage of conveying gas under greater pressures than are at present usual; and further on he gives more exact formula for the flow of gas in pipes—taking into the reckoning the change of volume and density. However, the outcome is that the author shows that the discharge of a main depends on the pressure difference per mile of main, and that with considerable but perfectly manageable pressure differences, much smaller mains could be used than are ordinarily adopted. All that is necessary is to have compressing machinery at the station, and pressure-regulating apparatus at the points of delivery. It is clear that in this way the economy of the initial cost of mains would be very great. The author reviews the work that has been done in high-pressure gas distribution in America and to a smaller extent in this country. In high-pressure gas-mains, the question of leakage and of the joints which are least likely to leak are of governing importance. He does not look with favour upon lead joints; and although he regards a joint made with india-rubber rings (as used on the compressed-air system in Paris) as an almost ideal one, he thinks that possibly it would be unsuitable for gas. He shows, by argument and figures, that he does not think leakage would be inconveniently large with high pressures. At the end of the paper, he deals with the distribution of gas for power purposes—particularly referring to Mond gas.

The paper produced a discussion of a very practical character. It was started by Mr. T. Goulden, of the Gas-light and Coke Company, who called Professor Unwin's attention to the work which was done some 30 years ago by Mr. G. C. Trewby in connection with the two 48-inch mains which bring gas from Beckton right away through London to Fulham in the west. In this case, they run up to an initial pressure of 48 inches of water, or about 2 lbs. on the square foot; and this high-pressure gas is either transferred to gasholders or allowed to pass direct by means of governors into the low-pressure system. Mr. Goulden is of opinion that, with the accumulation of pipes under the surface of the roads, high pressures must now be resorted to; but it is a matter in which it is better to "hurry slowly." It is, he also remarked, out of the question to consider the discarding of their cast-iron mains, jointed with lead, and put down steel mains to carry the high pressures mentioned in the paper. Speaking of escapes of gas, he pointed out that, the gas-mains running through valuable property, great care would have to be taken in carrying out the proposal now put forward. The speaker sought information from Professor Unwin regarding the friction thrown by bends. Mr. H. A. Humphreys made a most interesting contribution to the discussion by describing what the South Staffordshire Power-Gas Company are doing in connection with their Mond gas distribution system. He showed a section of the steel mains they have adopted; this particular pipe being 21 inches diameter, of the Ferguson locking-bar type. Every main is subjected before being laid to a pressure of 300 lbs. per square inch. After considerable experimenting, a simple lead joint, covered with a steel sleeve, has been adopted. The pipes are 28 feet in length. As to cost, it is found that 36-inch cast-iron pipes would run to nearly 50 per cent. more than steel pipes of the same diameter. The pipes (while hot) are protected with a bituminous coating laid on thick, and covered with cloth of open mesh wound on spirally. While still hot, a second covering is put on. The cost of this protecting covering is about 9d. per square yard. The Company have come to the conclusion that 7 lbs. per square inch is the pressure at which they can distribute most economically at the start of the work. From what he has learned during his journeyings in America, Mr. John West is satisfied that gas engineers will have to turn their attention to the distribution of gas in small pipes under pressure. The details of the story which he told in the "JOURNAL" for Feb. 2 last (p. 268) of the Cleveland experience came in useful for illustrating the subject. In connection with pipes used for high pressures, Mr. Charles Hawksley considers that their capability of bearing the unequal external stresses to which they will be subjected in various places will have to be particularly looked to. Experiments made by Mr. Alexander Wilson in running large quantities of air through pipes at varying degrees of velocity enabled him to say that Professor Unwin's formula worked out very closely with what was experienced in those trials. With the lower pressures, he found that the bends and tees did not give much bother; but when they reached the higher pressures, it was found that they only got through from 70 to 72 per cent. of the calculated quantity of air that they would have had if it had been a straight length of main. As readers have been made aware, Mr. George Helps has entered into high-pressure gas distribution; and he finds there is nothing complex about it. He has had his main under an average pressure of 9 lbs. for eight months; and yet the leakage for last year was less per mile of main than in any previous year. When he had put down about 3 miles of the 5 miles of high-pressure main, he made some tests, using one of Marsh's "Rotary" meters. The results were that with 5 lbs. pressure, 5000 cubic feet were passed per hour; with 10 lbs. pressure, 10,000 cubic feet; and with 18 lbs. pressure, 18,000 cubic feet. Mannesmann 3-inch steel pipes were used in 30 feet lengths. The first 3 miles of pipes were laid with lead joints; and from his experience with these joints, he is disposed to agree with Professor Unwin. The last 2 miles were laid with screwed joints. Mr. Helps said he was sure his Directors would be prepared to place the plant at Professor Unwin's disposal for test purposes; and Professor Unwin was pleased to accept the offer. An interesting contribution was made by Mr. A. W. Onslow of figures regarding high-pressure gas at Woolwich Arsenal; and these will appear in the full report in next week's issue. He does not see there should be any more leakage with high than with low pressure mains, if properly laid. There was little for Professor Unwin to reply to. One remark was that if elbows and tees are put in mains, then undoubtedly resistances are introduced; but with easy bends the resistances are comparatively small. He showed that he had been greatly interested by the experiences related in the discussion.

Roadways: Their Relationship to the Various Public Services.

There were still two papers and some general business claiming attention; and therefore an afternoon sitting on Thursday was imperative. Compared with the previous sittings, this was sparsely attended. On the first paper a well-considered argument was put forward under the above title by Mr. A. E. Broadberry. He claims that every public service—whether municipal or otherwise—should have proper provision made for it in the public road. But even at the present time, with the advantages of improved organizations and modern methods, it is unfortunately too often a matter of scrambling between various public services for positions in roadways. No one has any regard for anyone else, and frequently one public service encroaches on the works of another—sometimes quite unintentionally, owing to the lack of accurate records. It is deplorable that such a state of chaos should ever have existed, but far more deplorable that it should continue. The control placed in the hands of the local authorities by Parliament has failed to prevent an expensive confusion in the underground work; and for all the extra cost incurred by this, the public using the service has to pay. The failure of the present system of "control" is a subject of much comment by the author; and he shows how any disinterestedness the local authorities may formerly have possessed has disappeared through municipal trading. Though recognizing the difficulty, the author does not see any impossibility in harmonizing the conflicting interests in road works. He seeks a remedy in proper organization. Something is required above local control, which usually takes merely the form of veto instead of constructive policy. It is a matter of national importance, and the organization must be national in its application, so that engineers of every public service, wherever located from time to time in the course of their career, should follow the same principle. Every consideration seems to point to the need for establishing standard road sections. Naturally the section which was suitable for main roads would not be suitable

for side streets; but all roads could be classed and treated accordingly. Say, for instance, the classes were 100 feet, 90 feet, 80 feet, 70 feet, 60 feet, 50 feet, and 40 feet roads, with a separate standard adopted for each, and rigidly adhered to throughout the country whenever a new road is made or an old one reconstructed. It would then be easy for every engineer to know precisely where his and every other underground work is situated.

It can hardly be called a discussion that ensued; it was more in the nature of a conversation between members and the President. It was inaugurated by Mr. H. Tobey stating that a local authority have no more power in the streets than a gas undertaking. Any concern, he holds, that has a statutory right in the roadway can take their own course; it does not need any application to take any particular route. The President pointed out that Mr. Danckwerts had assured him that a local authority before they can demand a plan must show that they have works in the road which the work of the company concerned is likely to interfere with, and they can only ask for a plan to show how the company are going to treat that part of the roadway. As a rule, the right over the subsoil of a road does not belong to the local authority. It belongs, up to the middle of it, to the owner of the property abutting on each side of the road. Of course, so long as gas companies, under the sanction of Parliament have the right to go into the subsoil, they must subject themselves to parliamentary restrictions. Mr. W. B. Randall sought the President's opinion on the subject of reinstatement; and part of his reply was that what the local authority can ask for is that the road shall be reinstated with the same material, and in the same way, that existed before, to the very best of the company's ability. He gave sound advice in suggesting that in these matters there should be a consultation with the local surveyor. The Commercial Gas Company are now resisting a demand that they should lay a certain pipe in or on concrete. To meet the surveyor's demands would cost some 10s. per yard cube. Mr. J. L. Chapman finds a good way of escaping difficulties is to pay the local authority a sum to maintain the road; and the prices his Company are charged for this are not high. The inroad of tramways will, he also remarked, cause both gas and water companies to lay double sets of mains. The real point of Mr. Broadberry's paper as to standard road sections was altogether neglected.

Artificial Gas Illumination in Relation to Natural Light.

The final paper—which showed Mr. William Sugg's all-round study of the requirements for artificial lighting—was read by that gentleman; but time did not unfortunately allow of its discussion. It will be seen, when the paper is published, that the facts and figures he presented serve as a great object-lesson to those who have to provide artificial light. To be successful, it is necessary, he insists, that we should work in this matter in such a way as to imitate Nature; and therefore we ought to get a light, like the light which we see in the evening, "which is a good light, soft to the eyes, and does not strain the sight." In lighting schools, it would be much better to allow the gaslight to pass through glass; and this is especially so in regard to the incandescent gas-light. If the incandescent lights are enclosed in clear glass globes, the light is not so trying to the eyes—more especially if it is enclosed in a properly shaped white albatrine globes. Several illustrations were presented by the author to indicate the way in which he considers that the lighting fittings should be made. Mr. Sugg also discoursed delightfully on the use of rose coloured screens, to temper the slight actinism of the light, and to keep the light and heat from eyes and head. He notes the growing tendency to make incandescent lights too white, and holds that what is wanted is that the rays of light should be the colour of the sunlight and not of moonlight. Many hints are given from Mr. Sugg's long experience in these matters. It is clear from the discoveries that are now being made, of the effect of different qualities of light upon the human system, that the whole matter wants careful studying in relation to lighting, so as to get the most suitable light without any of the rays which are harmful to the eyes.

There was, at the close of the paper, a word of appreciation from the President as to Mr. Sugg's work. He characterized the paper as a very useful and practical one, in view of the suggestions contained as to the protection of our visual organs in connection with artificial lighting.

Elections of Officers and Members.

There was still some business to be cleared away. In the first place, the President announced the result of the ballot for the appointment of office-bearers. The notification that Mr. D. Irving, of Bristol, had been selected to follow Mr. Jones in the presidential chair was acclaimed with heartiness, as was the statement that the junior vice-presidency had been conferred upon Mr. Charles Hunt. Mr. Hunt goes on to the Council in succession to one of the retiring members; and the other vacancies are to be occupied by Messrs. Goulden, Jolliffe, and Meunier. Other officers were re-elected, and a number of candidates were duly passed into membership. Very fervently Mr. Irving acknowledged his election to the presidency, recognizing it as the greatest honour and distinction that could be conferred upon him by his own class or profession. As will be seen in the account of the excursion to Arundel on Friday, the members took an opportunity of repairing the omission (caused through the lateness of the hour at which this particular part of the business was taken up) of electing, as an Honorary Member of the Institution, the President of the Société Technique du Gas en France.

Thanks for Services Rendered: The Report of the Departmental Committee.

Thanks—well earned and well deserved—were showered upon those who have held office during the past year, and to all who had contributed to the making of the meeting a success by act of any kind. The indebtedness of the Institution to the Council of the Institution of Mechanical Engineers for the generous manner in which they had handed over their commodious lecture hall and ante-rooms for the three days' meeting was suitably recorded. This vote gave the President an opportunity of referring to the time when the Institution shall have a house of their own in London. This seems to be a matter which Mr. Jones has greatly at heart, for two or three times during the meeting he made mention of it. This suggests the likelihood that he is going to look further into the matter, to see whether something in this way cannot be done. It is to be hoped that it will not be long before, through his influence, some life may be given to this desire—ambitious though the scheme may at first strike one. The Duke of Norfolk was also thanked for the facilities liberally afforded members for inspecting the celebrated castle at Arundel on the following day. The services of the authors of the papers and of the Council were also cordially acknowledged; and then, in apposite terms, that old friend of the President Sir George Livesey moved a vote recording the feelings of the members regarding their President. His cordiality, kindliness, hospitality, and general conduct in the chair during the week were all recognized with great enthusiasm; and he had indeed fairly won all that was said and expressed, even to Sir George's description of him as an "ideal President." Being true, that which was said cannot be called either fulsome or flattering. But the occasion was made use of by Sir George to call attention to a summary of the report of the Departmental Committee of the Board of Trade on the several matters that had been referred to them in connection with the London Gas Supply—an apparently correct digest of which report had appeared the preceding day in "The Times." [The full text of the report is published for the first time in the "JOURNAL" to-day.] It was regarded as being "a very proper thing" for the Committee to have reported in favour of Sugg's "London" No. 1 argand burner, but as a very improper thing that they should have recommended that gas of any quality should be burnt in that standard burner at the rate of 5 cubic feet per hour. This was a point that Sir George held on to long, and impressed the seriousness of it (with telling effect as will be seen) upon those present. Out of the Committee one good thing has come, over which Sir George is highly gratified; and it is that, after working strenuously for it through the best of the public part of his professional life, the sulphur clauses, it is recommended, shall now be abandoned. The sincerity of the vote to the President brought from him a reply which showed how abundantly he felt recompensed for the part he had taken (which had been a large and generous one) in driving forward the interests and work of the Institution during his year of office. The position he had occupied he felt was "a proud honour and a great distinction," carrying with it

heavy responsibilities. The digression made by Sir George was also commented on by the President, who endorsed all that had been said. The recommendation as to the "5 cubic feet rate for all qualities of gas" he emphatically declared was an "outrage on common sense." Without dissent, the meeting, on the President's initiative seconded by Mr. Irving, passed, "in the interests of gas consumers and common honesty," a resolution condemning this particular recommendation as being obstructive to the progress of the gas industry in the direction in which it is now so surely and certainly going. Beyond all this, the meeting authorized the Council to send a deputation to the Board of Trade to lay their objection before them, and to show the unrighteousness of the proposal. "You are bricks," exclaimed the President, when this latter act proclaimed the feeling of the members. With a vote of thanks to the Auditors, the Hon. Secretary (Mr. J. W. Helps), and Mr. Dunn, the proceedings ended. An announcement was made before members left the room that the choice of Bristol or London as the place of next year's meeting was still in the balance.

A few words before closing this sketch of the work of the week. In every respect, in quality of material placed before the members, in the quality of the discussions, and in attendances (which were maintained at an almost constant high figure throughout), the meeting of 1904 stands unmatched over many years' records of similar annual events. That is the general opinion wherever conversation turned on the matter. A rough estimate made by the Hon. Secretary is that during the delivery of the address and the lecture, there were quite 300 members present, and close upon that number at many other times. At the only afternoon sitting on Thursday, quite 130 members were in attendance; and this is, remembering precedents, an excellent muster for an afternoon gathering. The quality of the proceedings and the success of the gatherings fulfil completely the prognostication which we ventured to make on first receiving a copy of the programme. Much of the success is due to the *bonhomie* of the President, who during the week was seen in lights and from points of view in and from which few, excepting his intimates, have had an opportunity of seeing him before. He has the gift of knowing how to engage—whether in meeting or at the social functions; and right well he exercised that gift. Those who placed him in the chair have departed from London convinced that their act on that occasion was one of the best in which they had ever had a hand. But there is not only the President. The Hon. Secretary and Secretary both worked indefatigably over the detail of the meetings; and no small measure of praise must be awarded to them.

SOCIAL EVENTS OF THE WEEK.

From the technical work, interesting though it all was, it is refreshing to turn to the lighter side of the week's doings. A number of men cannot be expected to meet together, more especially when accompanied so numerously as the members are on these occasions by the fairer sex, without opportunities for recreation and enjoyment in company. The organization of the arrangements for last week is a matter which the President, his friends know, has been regarding for some weeks as being of the gravest import; and the preliminary details gave him quite anxious concern, almost as much so as the subject-matter of his address.

The week's events of the social order would not be complete without mention being made of the fact that, following now well-seated custom, the usual fraternal greetings were accorded to provincial gas men of the craft by the Evening Star Lodge. For the purpose, an emergency meeting of the lodge was arranged to be held on Monday evening at the Holborn Restaurant. At its close, there was a banquet in the King's Hall, at which the chair was taken by the W. M. Bro. W. B. Randall. There were a few toasts (in addition to the usual ones) particularly applicable to the occasion, and subsequently there was a musical entertainment. Special reference should be made to the energetic attention on the occasion of the Secretary to the Emergency Committee (Bro. Walter T. Dunn), from whom we learn that the number of brethren present was 137. It was manifest that all derived considerable enjoyment from the *réunion*.

Wednesday evening brought with it the great social event of the week—that was the reception by the President and Miss Jones at the Hotel Cecil, with a Cinderella dance. Nothing was wanting to perfect the enjoyment of the occasion. From eight to nine, the President and Miss Jones were actively engaged in receiving their numerous guests (some 327 in all) and this they did with an affability that set the "ball" rolling with a joyous and vigorous spirit that was maintained until the hands of the clock pointed to the hour of midnight. Several personal friends of the President were among the guests; and they assisted him most heartily throughout the evening, though really he wanted little help, for he was frequently observed whirling round the room, to the strains of the Royal Roumanian Band, with an agility that was the envy of many of the younger men. But what more need be said? It was a good company bent on thorough enjoyment, with an excellent floor in a beautiful room, charming ante-rooms, and, in fact, with all the aids present to complete enjoyment. The result can be as well imagined as described in words.

The Excursion to Arundel.

It was a leaden sky that met the gaze of those on Friday morning who had been anticipating the pleasure of a trip to Arundel. However, the special train which left Victoria at 8.50 had on board (including a few picked up at West Croydon) a party of ladies and gentlemen numbering roughly 200. The President, Hon. Secretary, and most of the members of the Council were of the company. From Croydon the run was made to Arundel almost without stop. The inhabitants of the town were soon awake to the fact that something unusual was happening, though curiosity had been somewhat previously gratified by the more inquisitive having made, some few weeks previously, particular inquiries as to what was meant by the repainting of lamp columns and lanterns in the streets, and the gasholders, and other plant at the works. The party made an imposing line of life between station and Castle, the inspection of which was the second stage in the day's arrangements, and the first in Arundel itself. It is an uncommon thing for visitors to be able to gain admission to the private parts of the great historic castle; and the Institution must therefore feel themselves highly honoured in being granted such a privilege by his Grace the Duke of Norfolk. It was a privilege that was, indeed, very highly appreciated by the visitors; and they took advantage of the occasion by making a no mere cursory view. But while the party were in the rooms and among their valuable treasures, the rain began to descend with pitiless vigour; and not a great many possessed the hardihood to venture forth to view the castle park, keep, gardens, and the noble Church of S. Philip Neri. Before the time allotted to the castle and grounds had expired, most of the party were within the welcome shelter of the "Norfolk Arms." The idea of lunching in a marquee had had to be abandoned in view of the threatening weather; and the courteous and painstaking host of the hotel accommodated the whole of the number, by a little good generalship, well within his two largest rooms. A formal vote of thanks ought almost to have been passed to him for the way in which he arranged for the comfort of such a numerous company, who were allowed to invade his premises without let or hindrance.

The luncheon was a great success; and afterwards a few toasts were proposed—among them "The Health of the Duke of Norfolk," which was drunk with musical honours. It should before this have been stated that the Chairman of the Gas Company (Mr. C. Bartlett) and the Engineer and Manager (Mr. W. C. Dawson) had taken upon themselves no end of local organizing work in connection with this visit; and from the time the members landed on the railway platform at Arundel to the time they quitted it in the evening, these gentlemen (with other of the Directors) were attentive to the visitors to the last degree.

Well, it was from Mr. Bartlett that the toast of "The Institution of Gas Engineers and the President" came; and he made an appropriate speech, in which humour and wisdom shone out alternately. As Chairman of the Arundel and Littlehampton Gas Companies, and Deputy-Mayor of the ancient borough, he offered the Institution a very hearty welcome. He expressed regret that the weather had not proved more propitious, so that the members and their lady friends could have enjoyed the surrounding beautiful scenery. He recognized the great usefulness of the Institution in furthering the interests of the gas industry. He was afraid that in Arundel they could not, in respect of matters affecting the manufacture or the distribution of gas, teach the

members much; but those who had during the day an opportunity of seeing the works would notice that they had been smartened up a bit. While this work had been going on in anticipation of this visit, he had been asked whether the King was coming. (Laughter.) But the real object was that the members of the Institution should see the works clean—for once. (Renewed laughter.) If the visit did not result in any other good, it had been a good thing for the gas-works. The works, he mentioned, were started in 1838; and his grandfather was one of the original promoters of the scheme. After his grandfather, his father was a Director; and he (the speaker) had succeeded his father in the directorate. Therefore there had been a long family connection with gas. For the first few years of the history of the Company, the dividends were not very high; and the price charged for gas was 15s. per 1000 cubic feet. They did not charge that price now—(Laughter)—and the dividends were better. They had continued to progress, and had now one of the nicest little works in the country.

In his reply, the President took the opportunity of repairing two omissions from the business proceedings the previous day. In the first place, he said he had intended to explain to the members why there had been no prizes or medals for papers awarded this year. At the meeting last year, it was a difficult thing to get papers, or to invite them on the ordinary footing. This meeting ended the first clear year after the reunion; and the papers which were read at this meeting would receive premiums at the next meeting. None the less did they all feel indebted to those gentlemen who read papers at the meeting in 1903. He also wished the members to approve, with heartiness and warmth, the recommendation that they should add to the list of honorary members the President of the Société Technique du Gaz en France. Although he (Mr. Jones) was originally a subscribing member of the Société Technique, they did him, as the President of the Institution, the honour of electing him to be an honorary member; and he was sure the members would wish to be not less gracious. (The motion was very heartily endorsed.) Proceeding, the President dilated in a breezy fashion on the subject of the recreation of the Gas Engineer. He also, before wishing the members "Godspeed," congratulated them upon having elected Mr. Irving as his successor; referring to him as an able and competent engineer, and a man of careful judgment. He thanked the Chairman of the Gas Company for his kind words, and congratulated him and the shareholders on the progress that had been made under the management of Mr. Dawson.

The rain had now ceased, and, though it continued dull, most of the party had a very enjoyable drive through the picturesque park and neighbourhood. One gentleman from across the Border was heard to remark that now the members had been to Arundel, they would not want to go to Scotland, which is saying something for Arundel. A few also visited the gas-works. The afternoon, however, was considerably curtailed, owing to the heavy rain of the morning having induced those in authority to arrange, and wisely so, with the Railway Company for the return journey being made nearly two hours before the appointed time. Consequently, tea was provided at 4.30; and a start for London was made about 5.30—Victoria being reached a few minutes after seven. There and then ended the great and successful gathering of the profession for 1904.

GENERAL REPORT.

The Annual General Meeting of the Institution was held on Tuesday, Wednesday, and Thursday last week, at the Institution of Mechanical Engineers, Storey's Gate, Westminster—Mr. H. E. Jones, M.Inst.C.E., the President, in the chair.

Confirmation of Minutes.

The President suggested that the minutes of the last meeting should be taken as read.

Mr. H. Townsend (Wakefield) seconded the proposal; and it was unanimously agreed to.

The Report and Accounts.

The Secretary (Mr. Walter T. Dunn) read the report of the Committee (*ante*, p. 502), to which was appended the statement of accounts.

The President said he must first of all congratulate himself and the Council on such a goodly gathering. If ever a doubt had existed in anyone's mind as to the future of the Institution, it must be dissolved by a glance at the well-filled benches before him. They might also congratulate themselves on the addition of 31 members to the roll; and their veteran Honorary Member, Sir George Livesey, on his having been once again honoured by His Majesty and sent to the St. Louis Exhibition as a Royal Commissioner. Their satisfaction, however, must be to a certain extent diminished when they referred to the list showing the losses which death had made in their ranks during the past year. The first name on the list was connected with the town of Wolverhampton, where, many years ago, as a boy, he first learned to know what gas making meant. Mr. John Annan had been twice Mayor of Wolverhampton; and his career exemplified the rewards which awaited those who performed sterling, steady, and conscientious work. Mr. Thomas Fletcher, of Warrington, had also left them; and he (the President) was happy to think that he had been placed on the list of Honorary Members, for few names were more widely known in connection with the various uses of gas. He was, indeed, well known all over the world; and he (the President) himself had been concerned in sending some of his productions to Bombay in the East and to Buenos Ayres in the West. The death of Mr. William Foulis was an irreparable loss to the Institution. He sent a letter to the Technical Press, on the spur of the moment, testifying his keen sense of personal loss when he heard of the death of this distinguished engineer. Though he noticed, after the meeting last year, that Mr. Foulis did not look very well, he was far from expecting the sad news which reached him shortly afterwards. He was particularly drawn to him, because he was, in every sense of the word, a typical ideal gas engineer. He had all the attributes of a kindly, genial gentleman; he had a thoroughly scientific grounding in education and training; and his works remained behind as a record of the services he had rendered to the community of Glasgow by establishing magnificent works at a very economical expenditure. The other names on the list were all known to those present; but there was one who was more distinguished almost than any who had gone before—viz., Frederick Siemens. He was one of the first to earn the distinction of the Birmingham Medal, and right worthily so. Many years ago, he (the President) remembered the feeling almost of consternation which many persons felt when the scheme was announced for supplying Birmingham with gas on a system under which the carbonizing was to be effected by generator firing, which at that time was unknown in this country. They had lately been saddened by the unhappy death of a humbler man—Mr. Dexter; and they must all regret the sad circumstances under which that death occurred. Other matters were touched upon in the report, which he need not deal with at length; and he might dismiss them with the hearty congratulations of the Council to the members on the fact that the somewhat ambitious scheme of the former President, Mr. Dougall, had been so happily forwarded by the affiliation of local Associations. It was no mean work for the Council during the past year to have brought about the result stated, that no less than four of these important bodies had joined them, and they felt assured that a fifth—the Southern District—would very soon come in. He was never better pleased than when, on a hasty visit to Mr. Helps at Nuneaton on the previous Thursday, he saw the unanimous and hearty vote of the Midland Association to join the Institution. He felt certain it would only be a question of time when they would all come in; for those who at present did not see the advantage of doing so would learn that union was strength, and that, on the ground of representation alone, such as that which he unworthily had on the Committee of Engineers, it was of great importance. This representation would not have been possible if they had still been a divided body. They had lately been recognized another way, having been invited to send two representatives to the Standards Committee; and Mr. Hunt and Mr. Carpenter had been appointed. They were much indebted to the two gentlemen who had undertaken to be responsible for the technical dictionary—Mr. Dougall and Dr. Colman. They had embarked upon a rather ambitious programme with regard to an International Exhibition. He did not like undertaking either the financial or the moral responsibility of a thing of this sort, unless he had a united

Council at his back. But he was pleased to say that the vote was absolutely unanimous; and, committed as it was to the able hands of those whose names appeared in the report, they might feel sure that the exhibition would be a thorough success. He concluded by moving the adoption of the report and accounts.

Mr. ISAAC CARR (Widnes), in seconding the motion, expressed his appreciation of the remarks which had fallen from the President with reference to the losses that the Institution had sustained by death during the past year, especially with regard to those two eminent men, Mr. Foulis and Mr. Fletcher. He confessed that when he read the report he thought the few lines devoted to this topic were an insufficient record on the part of the Council of the lifelong and eminent services to the gas industry of these gentlemen; and he was very glad that the President had made some amends for the deficiency. He hoped that in future, when they had the misfortune to lose gentlemen of this description, some fitting reference would be made, either in the Council's report or in the Transactions, to the good work done by them.

The resolution was carried unanimously.

President's Address.

The PRESIDENT then delivered his Inaugural Address, which was given in the "JOURNAL" last week (p. 630).

Mr. J. HEPWORTH (Edinburgh), in proposing a vote of thanks to the President, said that most of those present had listened to presidential addresses before—some of them to a great number; but it was no mere compliment to say that no such address had impressed him more than the one they had just heard. From beginning to end, the interest had been sustained; and he had rarely listened to an address where he had felt so much tempted to discuss the facts and opinions with which it bristled. But this, of course, was not permissible. All they had to do was simply to pass a vote of thanks to the President for his able and comprehensive address. They would not be likely to forget the many points touched upon; but he might say he had been specially interested in what Mr. Jones had said about the education of the engineer, and they would all do well to consider the recommendations he had made out of his long and valuable experience. The engineering details, the scientific problems, and the administrative subjects which he had introduced, would all constitute matters for study, and for congratulations to the President long after that day. They were much indebted to him for having given them so wide a review of the great questions connected with the gas industry.

Mr. R. O. PATERSON (Cheltenham), in seconding the motion, felt sure that there could be only one feeling among the members present—that they had had an exceedingly pleasant address, a very able and suggestive one, and altogether one that was characteristic of the President. He remembered in the earlier days, when he was actively engaged in the work of the Gas Institute, how they all regarded the absence of Mr. Jones from the roll of membership. He hardly knew whether or not it was a matter for regret, because perhaps the very fact of his having been so long absent was the means which promptly brought him to the top of the list at an important and critical time. Altogether, they had in the President an instance of the right man appearing at the right moment. Perhaps if Mr. Jones had been called to preside over such a meeting while he was in the trammels of an active appointment, he would not have been such a free man on the platform as he had now shown himself. His mouth was opened, and he could speak freely; and he had spoken in a very instructive manner. He (Mr. Paterson) did not know that he had ever heard an address—referring especially to the latter part—which had more impressed him with its power and force, and with its enormous amount of accumulated knowledge and experience. It was one of the best addresses they had had.

The motion was carried unanimously.

The PRESIDENT, in acknowledging the vote, after thanking the members for the hearty way in which they had responded to the flattering expressions of the mover and seconder, said he had written a great deal more than he had read, so much was he in love with the subject; and among the things he had left out was about the Benevolent Fund. The members would not, however, he was sure, leave it out of consideration. If what he had said did not harmonize with the views of all, if it was suggestive of possible controversy, he could only say it was his conscientious message at the end of 42 years of hard work in their own ranks. Whatever else he might be, he had been a hard worker in the direct work of a gas undertaking. He now enjoyed the liberty of which Mr. Paterson had reminded him. Mr. Gladstone once said he had greater freedom and less reponsibility. He (the President) did not know that the responsibility was less; but he did now enjoy a certain amount of ease and leisure. That enjoyment, however, was coupled with one drawback. It divorced him from the works and workfellows he had learned to love; and it also weakened his authority to speak. The humblest man present who, from his own little gas-works, knew some fact from his own observation, had more right to speak than a man living in Westminster, far away from daily experience. He had spoken of the grand future which he thought was open to the gas industry. Art was long, but life was short. He had seen a great many years of work, and his face was now turned the wrong way; but those before him were turned the right way. There was youth with action to win this field. United in the Institution, so potently reinforced to-day by four accessions, he would ask them to let its service rally them from heated divisions, in partisan camps of opinion, to the cooler and more dignified and impartial tolerance of abstention which benefited the judgment, making the Institution a bond of inspiration and of distinction. It would then become a power to help them, and a protection to guard them. He wished them all God speed.

The Lecture and Papers.

The reading and discussion of papers was then proceeded with. We give in another part of the "JOURNAL" Professor Dixon's lecture and the papers taken on Tuesday and Wednesday, with the discussions thereon. The remaining papers and discussions will be given next week.

The Benevolent Fund.

The PRESIDENT took the chair at ten o'clock on Wednesday morning; and the first business to occupy attention was connected with the Benevolent Fund.

The minutes of the last annual meeting having been read and confirmed,

The SECRETARY read the annual report, which was given in the "JOURNAL" for the 24th ult. (p. 503).

The PRESIDENT, in moving that the report and accounts be adopted and entered on the minutes, remarked that though the total receipts for the past year were £117, against £100 the year before, £17 was accounted for by special donations. While they were much obliged for these, they felt that the best source of income for the fund would be small annual contributions from a large number. It was far better that such a fund should be on a broader basis, and not depend on the liberality of a small number. He did not know that anything he could say would enhance the heartfelt anxiety of the Committee about the fund. It was clearly the duty, well recognized in all communities of English people, that the prosperous should make provision for those who were less fortunate; and one of his most pleasant experiences was to have been associated with the Benevolent Fund of the Institution of Civil Engineers. But there they had the same difficulty in impressing upon the bulk of the members that a small amount from each would be a source of greater strength to the fund than the large sums contributed by a few. Like themselves, however, they found that the fund was, for the time at any rate, adequate to the demands upon it; and this knowledge rather dammed the tide of charitable feeling. The accounts for the past year showed a clear balance of £113, even out of the small aggregate income of £206. But this addition to the capital did not bring it above £2500; and with a body numbering 715, they would all agree that it would be much safer to have a larger capital sum in hand. For some time, therefore, he was in doubt as to whether, instead of contributing to a fund for a gold medal (as already announced), it would not be better to hand over the money to the Benevolent Fund. But, on discussing the matter with one of the oldest members, he was assured that, whenever the necessity arose, there would be no doubt about the requisite funds being forthcoming. He therefore decided that, as they must first get engineers before they required to provide for their necessities, the more fruitful way even of making some little addition to the capital funds of the Institution would be to stimulate the young engineer in his professional ambition, by inducing him, if possible, to give more carefully prepared contributions to the meetings,

and so strengthen the whole organization. He need not labour this, but he hoped all the members would contribute, if only a few shillings annually, to the Benevolent Fund.

Mr. J. West (Manchester) seconded the motion.

Mr. T. Duxbury (Manchester) suggested as a means of increasing the subscriptions, that those members of the old Gas Institute who were not qualified to become members of the Institution, and who numbered about 125, should be allowed, or invited, to attend the meetings, without the right to speak or vote, many of whom would, he believed, contribute a guinea or perhaps more to the fund. He suggested that the names of these gentlemen should be printed in a separate list in the Transactions.

Mr. W. W. Hutchinson (Barnsley) cordially endorsed the suggestion, and expressed the hope that it would be taken into serious consideration.

The President said he was bound so say that he could not conceive any shabbier treatment of any gentleman than to try to stimulate his charitable feelings towards the more unfortunate members of an association, while refusing him the privilege of membership. It would also be very poor treatment to ask him to come to meetings where he could not vote, and had no recognized position. He did not think the kind suggestion of Mr. Duxbury, who was himself an honorary member, would commend itself even to the gentlemen to whom he referred. He could only say that if such a proposition were made to him, he should decline. The Council, however, had instructed the Secretary on no account to refuse a contribution or donation from any source whatever. It might be from an American engineer, who never came to the meetings. But, on the other hand, he was not on any account to solicit contributions from those who could not, by their constitution, become members of the Institution.

The motion was then put and carried *nem. con.*

The President next announced that, as the result of the ballot, the vacancies on the Committee had been filled by the election of himself and Mr. James Randall. He was delighted to find that the members had invested him with this responsibility in connection with the fund, and he was sure he might say the same for Mr. Randall.

This concluded the Benevolent Fund business.

Officers and New Members.

At the conclusion of the technical business on Thursday,

The President announced the result of the ballot, as follows:—

President: Mr. Daniel Irving, Bristol.

Junior Vice-President: Mr. Charles Hunt, of London. (Mr. Charles Wood, of Bradford, is the Senior Vice-President.)

Members of Council: Mr. Thomas Goulden, Mr. Charles Hunt, Mr. J. T. Jolliffe, Mr. S. Meunier.

Mr. Irving said he must return his sincere thanks to the members for electing him to the presidency. He regarded it as the greatest honour and distinction that could be conferred upon him by the profession. At the same time, he was mindful of the very able and distinguished men who had previously occupied the chair—men filling the very highest positions in the profession; and therefore he must be forgiven if he said that, in thanking the members for electing him, he accepted the office with some feelings of fear and apprehension. The responsibilities of the Institution seemed to be growing; and having regard to all these considerations, he felt some diffidence in accepting the office. He could only rely on the co-operation of the Council and the members generally to enable him to carry out, in any way successfully, the good and useful work of the Institution.

The President then moved the election of Mr. W. D. Child and Messrs. Wood, Drew, and Co. as Auditors.

Mr. S. W. Durkin (Southampton) seconded the motion; and it was carried unanimously.

It was announced that all the new members proposed [see p. 778] had been unanimously elected.

Votes of Thanks.

The President then moved that the thanks of the Institution be given to the Council of the Institution of Mechanical Engineers for their kindness in granting the use of the hall, and for all the facilities they had extended to them in connection with the meeting. They had enjoyed the hospitality of the Mechanical Engineers with great advantage, as theirs was one of the best halls in London for such a purpose; and it had been well filled. One feature of societies of this kind—and he hoped it would some day be a feature of their own, when they had a hall, to which he had been looking forward—was that they freely and hospitably lent their meeting-places to other Associations needing them.

Mr. J. L. Chapman (Harrow) seconded the motion, which was cordially agreed to.

Moved by the Hon. Secretary, and seconded by Mr. A. E. Broadberry, a hearty vote of thanks was passed to his Grace the Duke of Norfolk, for the special facilities he had afforded to the Institution to visit his castle and grounds on the following day.

Mr. N. H. Humphrys (Salisbury) moved a vote of thanks to the authors of the papers. He said all would agree that they had had an excellent programme of papers, which had all been opportune and up to date. There never was a time when it was more necessary than now that they should keep themselves well posted up in the general principles of the profession they represented; and if they all took home and read and digested what they had heard, he was sure they would be benefited by it.

Mr. A. Wilson (Glasgow), in seconding the motion, said the excellent attendances at the meetings showed that the interest had been kept up right through.

The motion was carried unanimously.

Mr. R. Bruce Anderson (London) moved a vote of thanks to the Council for the excellent manner in which they had conducted the affairs of the Institution during the past year, and especially for their successful efforts in bringing about the affiliation of other societies.

Mr. W. R. Cooper (Banbury) seconded the motion, which was carried unanimously.

Sir George Livesey said he was perhaps hardly entitled to propose the vote of thanks he was going to submit, because, though he had been in and out of the meetings, and had formed some fair idea of the nature of the proceedings, he had been unable to attend with anything like regularity. Still, he had seen enough to show him that the President was thoroughly deserving of the most hearty thanks that they could offer him. The labour expended on the admirable address he had delivered, the efforts he had put forth to make the meeting successful, his cordiality and kindliness to all the members, his hospitality, and altogether the manner in which he had conducted the meetings, showed that he had been an ideal President. He (Sir George Livesey) was perhaps Mr. Jones's oldest friend, for he first knew him when he was Engineer and Manager of the Wandsworth Gas-Works in the sixties, and he was now Chairman of the Company. He had consequently had a pretty long connection with it; and it was evident that the work he did in those early days was thoroughly satisfactory. They were fortunate in having a man of his experience as President; and he was sure they would join in a hearty vote of thanks. Before sitting down, he hoped he might be excused for going a little beyond his text, and referring to a subject which was very near to them all, and that was the question of the Departmental Committee of the Board of Trade. He was not in a position to say anything about the matter beyond this—that a summary of the conclusions of the Committee had appeared in "The Times" on the preceding day, which he was informed was correct, so far as it went; and there was one recommendation which affected them all. "The Times" said they understood that the Committee recommended that the standard burner to be used for testing the illuminating power of all qualities of gas should remain, as at present, Sugg's No. 1 "London" argand, and that the chimney should be of uniform size—6 inches long, $1\frac{7}{8}$ inches internal diameter. This was all right; but it then went on to say that for the purpose of determining the nominal illuminating power of gas of any quality, the gas should be burnt in the standard burner at the rate of 5 cubic feet per hour. This was the point to which he wished to draw attention. There was to be one standard burner for all qualities of gas, which would apply not only to the Metropolis, but doubtless throughout the kingdom; and in all Acts of Parliament this would become the standard burner. But that it should be used for determining the illuminating power of any gas to be burnt at the rate of 5 cubic feet per hour, was utterly absurd. It was impossible to do anything like justice—in fact, it was

impossible to burn gas of all qualities at the rate of 5 cubic feet an hour in such a burner. If they were supplying 18-candle gas, and burnt it at the rate of 5 cubic feet an hour, the gas would tail a long way over the chimney. There would not be enough air to burn the gas, and there would be a large column of smoke. Conversely, if they were burning 13 or 14 candle gas at the rate of 5 cubic feet an hour, there would be too much air—the gas would be over-burnt, and the illuminating power of it greatly deteriorated. He thought he could throw a little light on this, because he was not bound to any secrecy. He was called as a witness, and was asked certain questions on the point, particularly with reference to 14-candle gas. It was admitted on all hands that what was known as 14-candle gas, tested in the standard burner at the 16-candle rate with a 3-inch flame, was what it professed to be; but if it were burnt at the rate of 5 cubic feet an hour instead of 5·7 cubic feet, it would only give a light of 13 candles. He was asked if he had any objection to having the gas described as 13 instead of 14 candles, burning at the rate of 5 cubic feet an hour. He said it was merely a name; but it was misleading, and did not convey to the public the proper idea of what the quality was. Moreover, that was not the way in which the public would burn it. On his second appearance before the Committee, he was again asked if he had any objection to the gas being burnt at the 5 cubic feet rate, and described as the quality that would give 13 candles. He said that he had, because it would be misleading. The gentleman examining him (Mr. Fletcher Moulton) said he agreed with this. He did not suggest it for the purpose of describing the quality of the gas, but merely for identifying it; and he thought when they got the full report they would find something of this sort—that the Committee recommended the gas to be tested at the 5 cubic feet rate, not to describe its quality, but to identify it. But what would happen? He hoped some day they would come down to 12-candle gas, and this would have to be described as 8-candle or 9-candle gas if it were tested at the 5 cubic feet rate, which was an utter absurdity, and something which they must do their best to have put right, because it was incorrect and misleading. One good thing had come out of the work of the Committee. They had got rid of the sulphur bugbear. Perhaps to 90 per cent. of the gentlemen present this was a matter of no interest, because they were not bound by the sulphur restrictions, though they might have had some trouble from the prejudice regarding them, and have had to use lime. But he understood it would be recommended that the obligation placed on the Companies with regard to the removal of sulphur impurities other than sulphuretted hydrogen should be abolished. It was worth a great deal to get this done; it was a matter for which he had been struggling for forty years, and never missed a chance of pressing the point. At last the South Metropolitan Gas Company undertook some very extensive experiments, which he thought had clinched the matter; and here was the result. The other point, however, would tend to retard their efforts in the direction of reducing the illuminating power of gas. On this, he agreed thoroughly with the President, in that part of his address in which he referred to the use for fuel of gas of low illuminating power as the *desideratum* of the day; and the recommendation would do very much to retard this great movement. He hoped he would be pardoned for this digression, and concluded by asking them to join in a hearty vote of thanks to the President.

Mr. T. B. Ball (Rochdale), in seconding the motion, said they must all feel under a great debt of gratitude to the President, and would heartily join in the vote of thanks to him for the services he had rendered. He quite agreed with the President-Elect that the responsibilities of the Institution were growing; and if they were to be adequately met, it would place, not only on the President but on the Council, very much heavier duties than they had hitherto borne. And when these were discharged so admirably as they had been on the present occasion, the least they could do was to give their heartiest thanks to the President for the admirable manner in which he got through them.

The motion was carried by acclamation.

The President, in acknowledging the vote, said that no higher reward could any man have towards the end of his life than to be put in a position of responsibility which brought him in contact with all those who had been working with him in the past; and when this was accompanied by the compliment of putting him in a chair which made him for the time being the representative of the whole profession, it was indeed a great honour and a proud distinction. But it certainly carried with it responsibility. This, however, was shared by them all; and he appealed to them, as this was the last time that he should speak in his present capacity, to bear in mind that if the Institution was to be what they were all ambitious that it should be, it would depend on their personal efforts in contributing good essays and observations on what they were doing, and good treatises on engineering processes and works. With regard to the digression which Sir George Livesey had introduced, he could not allow the occasion to pass without himself going into it. But it was not really a digression, because in his address he distinctly called attention to the very important and imminent consequences to all in the country of whatever might be taking place in legislation affecting the Metropolis. He began by telling them that the gas supply here was on a very large scale, and therefore very important; but he reminded them that if in the Metropolis any particular kind of legislation was enacted, they might be perfectly certain it would soon be introduced in the country. This question of the burner was of vital importance. Educated as they had been by the marvellously instructive lecture of Professor Dixon, in which they saw with what facility he demonstrated the separation of flames, and the extraordinary effect of a little addition of air, a little humidity, and so on—all this being developed, with a distinctness that they would remember all their lives—they must be struck with the importance of dealing with the air supply in the burners. Mr. Sugg, who had been talking about the way in which they should use the light, had always told them that every quality of gas required different treatment in the burner—a different amount of air for consumption. What had they foolishly done? They had inserted his name into every Act of Parliament in the country, and allowed parliamentary agents, lawyers, and other people who knew nothing about it, without consulting him, to put into Acts of Parliament a clause that the gas should be tested in a No. 1 "London" argand burner bearing that name. Now the No. 1 "London" argand burner was specially made for the Referees in 1868 for use with London gas, which was then enacted to be, to a large extent, of 16-candle power; and the rest were to follow. Mr. Sugg worked for a 16-candle standard. When his (the President's) Company at Wandsworth wanted a burner for 14 candle gas, they did not put a No. 1 "London" argand into their Act. They went to the man who made the burners—Mr. Sugg—and he said: "Here is a burner for 14-candle gas." The burner he made for Wandsworth and Brentford, when applied to the Commercial Company's gas, would make it 15¼ candles; but a No. 1 "London" argand, burning in the manner Sir George Livesey advised that it should be burnt, made it 15 candles, because they gave a little margin. But this lamentable recommendation, which filled him with disquietude for the future of the Commercial Gas Company, would bring down the same gas to about 13 candles. In the Commercial Company's district, they had two Local Authorities supplying electricity, and there was keen competition. They had beaten them in the fuel field by selling gas at 25 per cent. discount; but in the lighting field they could not make such a reduction, and had to keep them at bay by industriously circulating the proper facts with regard to the illuminating power of the electric current and of gas. Under this recommendation, they would have to stamp their gas as 13 candle if this report was adopted; and if they wanted it to appear to be 14 candle they would have to make it nearly 16 candle. It was an outrage on common sense. The Departmental Committee was constituted at the instance of the County Council to investigate this subject, with the result that the Commercial Gas Company's Bill was only passed for three years awaiting its decision. He felt that they had a tribunal of intelligent scientific gentlemen; and he was only afraid that they were too scientific, and not practical enough. As he pointed out in his address, a man without scholastic attainments, but a good mechanical engineer, was the man they wanted. On this Committee they had high science; and this was the result. He should like to be fortified by an expression of their approval, or weakened by an expression of dissent, on this matter. They had some splendid pioneers in the Institution. There was the gentleman from Nuneaton who was already delivering gas at 25 lbs. pressure, and another gentleman from Malton who lately was

so public-spirited as to make a contract with the local Electric Light Company to supply them with gas for power purposes for five years by a surrender of price. He would call on these gentlemen, as sympathizers with him in seeking to extend their operations, not only by this great supply of fuel and power, but in economy of the national supply of coal; and he ventured to say that the bulk of those present would be in accord with him if he called for a show of hands, as he felt inclined to do, if it would not be irregular, in favour of a resolution setting forth their entire dissent from any recommendation from an authoritative source which tended to handicap the industry, and force them to mis-describe their gas as being of inferior value to that which it really was, especially in face of the intense competition with the electric light all round. Mr. Helps told him there was no objection to passing a resolution; and he would therefore put it, and ask the Institution, as representing the leading gas engineers of the kingdom, to join with him in carrying one to the effect that they regarded the continued use of the No. 1 "London" argand burner, which was expressly constructed by Mr. Sugg for burning 16-candle gas, for testing gas of several qualities, when that gas was burnt at the fixed rate of 5 cubic feet per hour, as highly objectionable. He did not object to the burner being used (though it was not so good as others which could be made), but to the regulation, as being obstructive to that development of the industry which was most to the good, not of shareholders alone, but of consumers of gas.

Mr. IRVING said, in the interest of the gas consumers and of common honesty, he had much pleasure in seconding the resolution.

The proposition was put and carried unanimously.

The PRESIDENT said they had now thanked him in a manner he appreciated from the bottom of his heart. He would put the resolution in proper form; and he had no doubt they would authorize him and the Council to appoint a deputation to wait on the Board of Trade and explain their views.

On the motion of Mr. H. TOBEY (Malton), seconded by Mr. F. CLARK (Southend), a vote of thanks was accorded to the Auditors.

Mr. IRVING then proposed a vote of thanks to Mr. James W. Helps, the Honorary Secretary. He said they had had experience of brilliant and distinguished Presidents. Presidents came and went, but the Secretary remained. How valuable the energetic and inspiring labours of Mr. Helps were could only be known to those who were in close communication with him on the Council or in the chair. How much they were indebted to him, time would fail to tell; but his organizing capacity, his geniality, the wonderful power of inspiration he had on others, were all at the service of the Institution, and he (Mr. Irving) trusted their Honorary Secretary might long be spared to occupy the position he so well filled.

Mr. H. TOWNSEND (Wakefield), in seconding the motion, said he could endorse every word which had been used by the President-Elect as to the Honorary Secretary.

The PRESIDENT said he could not put the motion without offering a few remarks upon it. He had had a year's experience of the duties of the office of President under the great assistance which Mr. Helps had rendered. He had kept his hand on the helm of the ship through a most important period—practically a crisis; but he had steered it with tact and judgment, and had always been able to help him and every member of the Council with useful information.

The resolution was carried unanimously.

Mr. HELPS, in response, said it was always a great pleasure to him to do all he possibly could to further the interests of the gas industry in general and of the Institution. Practically they were synonymous terms. He had enjoyed last year's work very much indeed. They had had a great deal of work in connection with Council meetings; but they had fortunately been able to get through it.

The PRESIDENT next proposed a vote of thanks to the Secretary (Mr. Dunn), who, he said, was a good organizer, a faithful worker, and always at his post. He wished that he had an office of his own; and he might say, now that he had left the chair, that this was the object to which he intended to devote himself. He intended in some way to get funds together so that the Institution might have a house of their own, with proper offices, laboratory, and a theatre.

The vote of thanks having been carried unanimously,

Mr. DUNN briefly acknowledged it.

THE LECTURE.

THE MECHANISM OF COMBUSTION

By HAROLD B. DIXON, M.A., F.R.S.

Professor of Chemistry and Metallurgy in Owens College, Manchester

The privilege of addressing this Institution is one which I esteem a high honour, and also a grave responsibility. To a man who has pursued pure science, it is always gratifying to find that practical men can appreciate his work; but, at the same time, in addressing a meeting of experts such as this, I cannot be unaware that I am facing a body of professional critics who are well armed and highly trained. It is a venturesome thing to speak to you on the burning of that substance which you spend your lives in manufacturing. I am conscious that you know far better than I do what has been accomplished on the lines of economic working with regard to both making and burning gas—for on these matters I do not claim to be an expert; and what you do not know would, no doubt, go into the proverbial pill-box. But when I recall the great changes that have taken place in gas manufacture, and the total revolution in the processes for developing light from gas during the past few years, I can well believe that the future may be still richer in surprises, and that much may be gained from a minute study of the chemical processes in flames—of the "Mechanism of Combustion"—a subject of fascinating interest, but intricate and difficult to the last degree. It is a tangle whose outer fringe we are only now beginning to unravel.

Though Newton, in the Seventeenth Century, made one of his brilliant guesses when he called flame "white-hot smoke," and though Robert Hooke rightly explained that the "nitre air" in the atmosphere "preyed upon" the outer parts of the combustible vapour rising from a candle-wick to produce "that shining transient body which we call flame," and that "the inner parts are not turned to shining flame until they rise and meet the free air," nevertheless little was done on the nature of the chemical changes in flame until Humphry Davy took up the subject. In 1817, Davy made those well-known experiments on the extinction of flame in gases passing through metallic gauze, which led to his construction of the miner's safety-lamp. He noticed that when a gas-jet was lit above the gauze, and the gauze was raised, the luminosity of the flame diminished, and the flame "burnt blue." He rightly attributed the loss of light to the admixture of the gas with the air; and he advanced the theory that the light of hydrocarbon flames is due to a separation of solid carbon owing to the heating of the hydrocarbons in the interior of the flame, and that air previously mixed with the gas prevents such separation by oxidizing the carbon.

This explanation of the air-gas flame, though correct in the main, was not complete. It ignored the effect of the diluent nitrogen in preventing the separation of the carbon. It remained for Blochmann to show that mere dilution, apart from oxidation and from cooling, can destroy the luminosity of the flame, and for Wibel to show that mere cooling, apart from oxidation and dilution, can also do so. These views may be illustrated by the dilution of a coal-gas flame by carbonic oxide, which destroys the luminosity though it raises the temperature, and by the cooling of a luminous flame by adding water to a crucible suspended in it. We may say, then, that there are three causes which destroy luminosity by preventing the separation of carbon in an air-gas flame—(1) the oxidation effected by the oxygen, (2) the dilution, (3) the cooling effected by the nitrogen.

But Davy's theory of the cause of luminosity in hydrocarbon flames was challenged, first as to the fact of the actual separation of solid carbon, and secondly as to the mode by which such separation is effected. Edward Frankland, founding his opinion on his experiments on combustion under diminished and increased pressure, considered that the luminosity might be due to heavy hydrocarbon vapours in the flame. Heumann showed conclusively, I think, that solid particles of carbon were present in the flame, and were adequate to produce the luminosity.

The second variation on Davy's theory had a more widespread influence. Faraday, I believe, is chiefly responsible for spreading what may be called the heresy of the preferential combustion of the hydrogen. In his celebrated lectures on the candle flame, he attributes the separation of the carbon to the supposed fact that, of the two constituents of the

hydrocarbons in the flame, the hydrogen has a stronger affinity for oxygen than the carbon has, and therefore the hydrogen breaks off from the carbon to unite with the oxygen, leaving its former partner out in the—comparatively speaking—cold. On what experimental basis Faraday founded this statement, I cannot discover. I have been informed by high authority among gas engineers that Faraday's view is supported by "the evidence of one's own senses." At all events, the most distinguished chemists believed it. I need only mention the names of Graham, Mendeléeff, Berthelot, Roscoe, and Armstrong. It was adopted in text-books both in England and abroad. Two generations were brought up on the doctrine; and for a young chemist to dispute it ten years ago savoured almost of impiety. However, Professor Smithells and I did venture to dispute it; and I believe to-day the text-books are not so dogmatic on the subject.

What facts are known concerning the incomplete combustion of such a hydrocarbon as ethylene? If we make a mixture of equal volumes of ethylene and oxygen, and fire it in a strong vessel, the oxygen has the chance of dividing itself between the carbon and the hydrogen or of combining preferentially with one or other:—

$$C_2H_4 + O_2 = \begin{cases} \text{(i.)} & CO + C + H_2O + H_2 \\ \text{(ii.)} & C_2 + 2\,H_2O \\ \text{(iii.)} & CO_2 + C + 2\,H_2 \\ \text{(iv.)} & 2\,CO + 2\,H_2 \end{cases}$$

This experiment, which I will repeat before you, I made in 1891, and was surprised to find that Equation iv. almost exactly represents the change. Instead of finding a large contraction of gaseous volume, owing to the formation of steam and the depcsition of carbon, the volume is almost exactly doubled, and an inflammable mixture of equal parts of carbonic oxide and hydrogen is formed. The final product, then, whatever may have been the intermediate changes, affords no evidence of the preferential combustion of the hydrogen, but exactly the opposite.

After making this experiment, I found it had been done before, and had been published by Dalton in 1810, and afterwards by John Davy. Kersten, in 1861, repeated it, and drew from it the conclusion that carbon is not separated in flames by preferential combustion of hydrogen; but, as we have seen, his work was forgotten. It has been urged that the argument drawn from the explosion of ethylene and oxygen is not valid with regard to the reactions going on at a much lower temperature in ordinary flames. I would reply, in answer, that the final products found have cooled down from the very high temperature of the explosion until they cease to react; and since changes in gases at high temperatures take place with great rapidity, the products finally left are the result of interactions which have proceeded through a whole scale of descending temperatures. Again, when steam is passed over red-hot carbon, the latter takes the oxygen from the hydrogen, and this happens at a temperature below that of ordinary flame.

There appears, then, to be no evidence of the preferential combustion of hydrogen; and the incomplete combustion of a hydrocarbon at a high temperature seems to give carbonic oxide and hydrogen. Please bear in mind that I do not say that no steam is formed at any stage of the incomplete burning of a hydrocarbon in explosions. It is highly probable that some of the liberated hydrogen molecules react with oxygen molecules when they meet in collision. But, if so, the steam molecules formed are reduced again promptly when they meet with the carbon. Again, I do not say that, in a luminous hydrocarbon flame, the hydrogen of any given hydrocarbon molecule does not burn first. I believe it generally does so. The hydrocarbon being decomposed by heat, the hydrogen forms a highly mobile gas, and the carbon aggregates into solid particles. The hydrogen molecules endowed with their own enormous rapidity of motion may soon reach the outer air; the solid carbon particles are carried slowly by the upward-spreading gas stream. What I deny is that the carbon is separated because the hydrogen is burnt preferentially.

If, then, a hydrocarbon burns in a limited supply of air so as to form carbonic oxide and free hydrogen, and any further oxygen present divides itself between these two gases, the combustion in the inner flame of a bunsen burner —for there are two distinct flames—will be of this kind; the carbonic oxide and the hydrogen, formed and only partially burnt in the inner flame, burning when they reach the surrounding air and producing the outer flame. The separation of the inner from the outer flame is best effected in Professor Smithells' arrangement of two tubes, one of which slides over the other. The inner flame strikes-back until it is arrested at the mouth of the smaller tube, while the outer flame continues to burn above. The gases formed in the inner flame may be syphoned off from the space between the two flames. The analysis of these gases shows that they form a mixture of partially-burnt carbonic oxide and hydrogen exactly analogous to that found when a mixture of carbonic oxide and hydrogen is exploded with a small quantity of oxygen. With ethylene, for instance, Professor Smithells found that the reaction in the inner flame may be expressed by the same equilibrium-equation as I have shown governs the division of oxygen between carbonic oxide and hydrogen in explosions. This result is most easily explained by the hypothesis that in the inner bunsen flame the simpler hydrocarbons are burnt first to carbonic oxide and hydrogen.

Bunsen's Theory of Discontinuous Combustion.

Berthollet's "Law of Mass"—now one of the chief cornerstones of our science—remained for fifty years after its enunciation a vague and qualitative expression. Bunsen was the first to put it to a quantitative test. Unfortunately the experiments he relied upon were few and defective, and the conclusions he drew were erroneous. It is sometimes true that the evil experiments men do live after them, and the good are oft interred—in "Philosophical Transactions." Bunsen's great reputation as a chemist, and especially as a manipulator of gases, led to a widespread belief in the discontinuous nature of chemical change—a belief still cherished in many quarters, for Bunsen was a man who inspired his pupils with a spirit of discipleship and devotion to his views. Bunsen considered he had proved that Berthollet's "Law of Mass" was modified by a special tendency to form compounds in simple ratios. He fired mixtures of gases in which one gas, oxygen, had to divide itself between two others, hydrogen and carbonic oxide, in the explosion; and he thought he observed that the compounds (steam and carbonic acid) formed did not vary regularly with the relative quantity of hydrogen and carbonic oxide present (as Berthollet's "Law of Mass" states), but that the ratio $H_2O : CO_2$ altered in sudden jumps from one simple ratio (*e.g.*, 1 : 1) to another (*e.g.*, 1 : 2).

This theorem of Bunsen's, which was thought by many of his adherents to apply to other chemical reactions, became, at the suggestion of Mr. A. G. Vernon Harcourt, the starting-point of my own investigations in 1876. I found that Bunsen had neglected a very important factor in the experiment—namely, the reaction between steam and carbonic oxide at the high temperature of the explosion. The gases employed must be dry, not wet, as Bunsen used them; and, moreover, if the steam formed in the explosion were allowed to condense on the cold walls of the vessel during the passage of the flame, the final products were profoundly affected. By keeping the walls above the condensation-point of the steam, it was possible to test the "Law of Mass" as Bunsen proposed; and it was shown that the final products depended on an equilibrium being reached between two opposite chemical changes—namely, the action between carbonic oxide and steam to form carbonic acid and hydrogen, and the reverse action between the carbonic acid and hydrogen to reproduce carbonic oxide and steam. Whatever the initial quantities taken, the final products agree with the equation—

$$\frac{CO \times H_2O}{CO_2 \times H_2} = \text{Constant.}$$

This equilibrium, which Professor Smithells found also held good for the gases produced in the inner flame of the ethylene air burner, represents, of course, the final stage reached as the products of the explosion cool down. It has been objected by Professor W. Nernst that one is not justified in applying the "Law of Mass" unless the reacting substances have been maintained at a constant temperature. The answer is that the equilibrium found is not that which existed at the highest temperature, but that which exists when the gases cease reacting; and the fact which I establish—that the walls of the vessels can condense steam during the reaction (and so modify the equilibrium)—proves that the gases do react during the (comparatively long) period of cooling. The experiments, indeed, form a series in exact quantitative agreement with the "Law of Mass." I agree with Bunsen that Berthollet's theorem can be tested

by this method. I believe it has been so tested, and has not been found wanting.

Experiments on Pressures Produced in Explosions.

Just as Bunsen was a pioneer in testing the "Law of Mass" in gases, so also he led the way in investigating the pressure and temperature produced by the explosion of gases in closed vessels. Here, again, his results led him to the erroneous conclusion that there was a discontinuous combustion in explosions. When electrolytic gas, or when carbonic oxide with half its volume of oxygen, is fired, only one-third of the mixture is burnt, according to Bunsen, raising the temperature of the whole to about 3000° C. No further chemical action then occurs until the gaseous mixture falls, by cooling, below 2500° C. Then a further combustion begins, and so on *per saltum*. Bunsen also, in the same paper, makes the important statement that the rapidity with which a flame spreads is synchronous with the attainment of the maximum temperature and with complete combustion. I do not know on what grounds he based this statement, which I have found to be nearly true of the detonation-wave itself (*l'onde explosive* of Berthelot), but wholly untrue for the initial periods of the explosion, as I will show during this lecture.

Other observers have, on the whole, confirmed the work of Bunsen as to the "effective pressures" produced in the explosion of gases. But, working with delicate indicators, Mallard and Le Chatelier found that, with all rapidly exploding mixtures, very high pressures were often produced during very small intervals of time. These fugitive pressures are due, according to Mallard and Le Chatelier, to the compression-wave which is propagated as the inflammation spreads from layer to layer, and may become of enormous intensity in the detonation-wave itself. As their object was to measure the mean pressure in the whole mass of gas, they abandoned the delicate indicator and used a Bourdon gauge. From the curves of pressures so registered they obtained expressions for the rate of cooling of the products of combustion, and so calculated the maximum pressures and temperatures of the explosions. Their results may be summarized in the statement that the maximum temperature of explosion of moist electrolytic gas is 3350° C., and the mean specific heat of steam between this temperature and 0° is 16·6—dissociation being very slight, if any, between these limits. On the other hand, the mean specific heat of carbonic acid rises to 13·6 at 2000° C.; and above this temperature dissociation begins. The diatomic gases (O_2, N_2, CO, &c.) also show a rise of specific heat, though far less marked than steam or carbonic acid exhibits.

In 1885, Berthelot and Vieille published their researches on the pressures produced in the explosion of gases. They measured the pressures by determining the maximum acceleration of a piston of known weight moved against gravity; making a correction for the cooling effect of the walls when a small explosion vessel was employed. From the maximum pressures, they calculated the maximum temperatures, arriving at results for hydrogen and carbonic oxide mixtures similar to those obtained by Bunsen and by Mallard and Le Chatelier. But whereas Bunsen attributed the defect of pressure observed to the inability of two-thirds of the gases to combine at the temperature reached, the French chemists attribute this defect of pressure to the great increase of the specific heats of the gaseous products of combustion. On the other hand, Dugald Clerk contends that in an explosion of gases combustion is not completed instantaneously, as the products of combustion are cooling while the unburnt particles are still combining; and therefore the maximum temperature reached never coincides with the theoretical temperature calculated for instantaneous combustion. The spreading of the flame throughout the vessel —*i.e.*, the inflammation of the whole mass of gas—is not coincident with the moment of maximum temperature and pressure. On exploding mixtures of coal gas and air and of hydrogen and air in a closed vessel, and registering the pressure with a Richards indicator, Clerk comes to the conclusion that neither dissociation of the products of combustion nor a rise in the specific heats can account for the fall of the observed pressures below those calculated. This fall must be accounted for by the gradual progress of the combustion.

Concerning the rise in the specific heat of carbonic acid, there can, I think, be little doubt that it really exists. Regnault and Wiedemann both found a distinct increase at constant pressure between 100° C. and 200° C. I have lately, in conjunction with Mr. F. W. Rixon, determined the specific heat of carbonic acid at constant volume at 100° C., 200° C., 300° C., and 400° C., and find a steady rise in the constant. On the other hand, the facility with which carbonic acid breaks up under the influence of electric discharges indicates that, as its temperature is raised, work is done in loosening the chemical bonds. Of the fact of the partial dissociation of carbonic acid and steam at the temperature of the detonation-wave, Mr. H. W. Smith and I found direct proof in the unburnt gases left on cooling.

I believe that in the detonation of gases—*i.e.*, in the explosion-wave itself—the temperature and pressure reached are largely influenced both by dissociation and by a preliminary increase in the specific heats. In the earlier phases of the explosion, and in mixtures where detonation does not occur (such as mixtures of coal gas and air), I believe that the gradual progress of the combustion also largely influences the temperature and pressure. So far as I am aware, no pressure diagram has been obtained which gives evidence of Bunsen's successive partial explosions.

Influence of Aqueous Vapour on Combustions.

It was while I was repeating Bunsen's work on the division of oxygen in explosions that I hit upon the curious phenomenon presented by a mixture of dried carbonic oxide and oxygen. I found that the dried mixture would not explode under the action of a spark which readily kindled the moist mixture, and that a flame of dried carbonic oxide burning in moist air is extinguished when the air is dried round it. I refer to this work (and show the experiment) not so much for its own intrinsic importance, as because it gave rise to some far-reaching generalizations as to the mode of chemical combination in gases, and because it became the starting-point for some marvellously exact work done by my old pupil, Brereton Baker, in the domain of "anhydrous chemistry."

If carbonic oxide is only oxidized through the intervention of steam—and (as Baker's brilliant work soon demonstrated) carbon, sulphur, and phosphorus are curiously inactive when heated in dried oxygen—may it not be that *all* oxidations are effected by the action of water, as that remarkable lady, Mrs. Fulhame, declared she had proved more than a hundred years ago? I agree with her that in the burning of carbonic oxide in air the water gives up its oxygen to the carbonic oxide, and the liberated hydrogen re-forms water by combining with the oxygen of the air—the hydrogen thus playing the part of "the carrier of oxygen." But I have not yet become (to adopt the expressive language of to-day) "a whole hogger" with regard to the influence of water vapour. Cyanogen can burn without requiring the presence of any water that can be detected. If you add any appreciable quantity, you retard the oxidation. When a mixture of hydrogen and oxygen, or of hydrogen and chlorine, is sparked, the explosion travels more quickly when the mixture is dried than when it is moist.

But there are distinguished chemists who take other views. As I cannot refer to all, I will more particularly speak of the views of Professor H. E. Armstrong, who has made perhaps the widest generalizations on the mechanism of combustion. His opinion is that chemical change and electrolysis are interchangeable equivalent terms, or that a chemical action is reversed electrolysis. There is no such thing as a simple change between two substances. Oxidation is an indirect process taking place in a circuit of the oxidizable substance conducting water and oxygen. For example, the burning of hydrogen by oxygen is brought about through the water—

(i.) $H_2 \mid OH_2 \mid O_2 = H_2O \mid H_2O_2$

The peroxide formed being either decomposed by heat or acting on more hydrogen through water:—

(ii.) $H_2 \mid OH_2 \mid O_2H_2 = H_2O \mid H_2O \mid H_2O$

In the burning of carbonic oxide, Armstrong originally suggested—

(iii.)
$$\begin{array}{l|l|c|l|l} CO & OH_2 & O & CO_2 & H_2O \\ & & \| & & \\ CO & OH_2 & O & CO_2 & H_2O \end{array}$$

But in his latest paper he suggests that water acts directly on carbonic oxide, producing formic acid—

(iv.) $CO + H_2O = HCOOH$

And the formic acid, either directly or indirectly, gives carbonic acid and hydrogen.

Now, it will be observed that, in Equation iv., Armstrong allows that a direct action may take place between carbonic oxide and steam. I am puzzled to understand why he cannot allow that they should react directly to form carbonic acid and hydrogen—a reaction which seems to me to be the simplest explanation of the facts.

With regard to the union of hydrogen and oxygen, I have been unable to detect that water vapour exerted any influence, when once the explosion was started by a spark. But Brereton Baker has shown that the very highly purified and dried gases do not explode in contact with a red-hot wire, although gradual union takes place. *Water*, therefore, is not the necessary "go-between," but, as Armstrong says, there must be *conducting* or *dirty water* present. Consequently, his first equation requires another term in it; for he has only included a molecule of pure water. This matter becomes important when we apply Armstrong's equations to the reactions in the explosion-wave. But when it is laid down that "dirty" water is necessary for the combustion of hydrogen, one feels tempted to ask whether some "dirty" gas would not do equally well. Most "pure" hydrogen contains some hydrocarbon, and, as Dr. Bone has shown, hydrocarbons are more easily oxidized than hydrogen. Baker has certainly proved that pure hydrogen ignites at a higher temperature than was supposed, but not that water, either pure or dirty, is necessary to propagate an explosion in pure electrolytic gas.

Dr. Bone, in an important series of experiments, has recently shown that, in the slow oxidation of methane and other hydrocarbons by oxygen below a red heat, water and aldehyde are gradually formed—

$$CH_4 + O_2 = CH_2O + OH_2$$

The formaldehyde so formed may break up into carbonic oxide and hydrogen, or be oxidized to oxides of carbon and steam. The oxygen, according to Dr. Bone, divides itself between the hydrogen and the residue of the hydrocarbon, and at no stage of the gradual oxidation is free hydrogen or free carbon evolved.

Armstrong considers that Bone's results bear out his views that the oxidation of hydrocarbons is effected by a series of successive "hydroxylations"—the oxygen being transferred electrolytically across "conducting" water—

$$\begin{array}{lll} CH_4 \mid OH_2 \mid O_2 & = CH_3OH & \mid H_2O_2 \\ CH_3OH \mid OH_2 \mid O_2 & = CH_2(OH)_2 & \mid H_2O_2 \\ CH_2(OH)_2 \mid OH_2 \mid O_2 & = CH(OH)_3 & \mid H_2O_2 \text{ \&c.} \end{array}$$

The formaldehydrol produced at the second stage breaks up into formaldehyde and water—

$$CH_2(OH)_2 = CH_2O + OH_2$$

and the formaldehyde is oxidized to formic acid, which, in turn, yields carbonic acid. It will be observed that in Armstrong's scheme the first oxidation product of a hydrocarbon is an alcohol. Dr. Bone has, however, searched for an alcohol in vain. He is now studying the slow union of hydrogen and oxygen as the gases are passed over porcelain heated to 420° C. The combustion would seem to be a "surface" action, and its rate depends on the quantity of hydrogen present, which appears to react in some way, either physically or chemically, with the heated porcelain. Can the hydrogen be held in a partially ionized state by the heated oxides of the surface material? It is an interesting problem, and I am glad to know that Dr. Bone is resolutely grappling with it.

But Professor Armstrong does not apply his electrolytic theory to systems at moderate temperatures only. He also applies it to explain the chemistry of the explosion-wave at enormously high temperatures. There is no reason why temperature should make any difference, he says. It is here that I differ from him. When ethylene is exploded with its own volume of oxygen, we have seen that carbonic oxide and hydrogen are formed in equal volumes; but, according to Armstrong, hydroxy-ethylene should first of all be formed. This might yield acetylene and water; and the acetylene would then be converted in the same way to carbon and water—

$$\begin{array}{lll} C_2H_4 \mid OH_2 \mid O_2 & = C_2H_3OH & \mid H_2O_2 \\ C_2H_3OH & = C_2H_2 + H_2O & \\ C_2H_2 \mid OH_2 \mid O_2 & = C_2HOH & \mid H_2O_2 \\ C_2HOH & = C_2 + H_2O & \end{array}$$

For the explosion of cyanogen with its own volume of oxygen, Armstrong gives the following cycle—

$$\begin{array}{ll} C_2N_2 \mid OH_2 \mid O_2 & = NCO\cdot CN \mid H_2O_2 \\ NCO\cdot CN + H_2O_2 & = NCO\cdot CON + H_2O \\ CO\cdot CO & \\ \mid \quad \mid & = 2\,CO + N_2 \\ N = N & \end{array}$$

Before I can criticize these views, I must touch upon the nature of the explosion-wave and its rate of propagation in different gases.

On the Rate of Explosion in Gases.

My first attempt to measure the rapidity with which an explosion is propagated through gases was due to my desire to test the theory to which I had been led regarding the mode of burning carbonic oxide. I thought then, and still think, that if the burning takes place through the direct interaction of the carbonic oxide and steam molecules, or even if it is necessary that molecules of carbonic oxide, steam, and oxygen should all be in contact at the same time, it must follow from the "Law of Mass" that if the steam is increased beyond the amount just required for combustion, the rapidity of the reaction will be increased. I found that it was so; but I also discovered that the rapidity of explosion of moist carbonic oxide and oxygen had been enormously underrated.

In the meantime, M. Berthelot and M. Le Chatelier, working independently of each other, had also examined the rates of explosion of gases. M. Berthelot made the important discovery that the rate of explosion rapidly increases from its point of origin until it reaches a maximum which remains constant, however long the column of gases may be. The rate of explosion thus forms a new physico-chemical constant, having important theoretical and practical bearings. The name *l'onde explosive* was given by Berthelot to the flame when propagated through an explosive mixture of gases at the maximum velocity. He next enunciated a remarkable theory to explain the propagation of the explosion-wave. He considered that it travelled at the mean rate of translation of the heated molecules formed in the explosion before they had time to lose any of the heat of chemical combination. This theory means that the explosion is propagated by the successive collision of the molecules against each other, just as a sound-wave is propagated through air. If it is true, it at once disposes of any scheme which depends on the juxtaposition of three or more molecules to bring about the chemical change which is propagated.

Although I do not agree with Berthelot's method of calculating the theoretical velocity of the explosion-wave, I think he grasped the essence of the matter. I have modified his formula, taking into account the fact that the wave must be propagated, not only by the burnt, but equally by the unburnt, molecules (with which the former exchange velocities), and that therefore half the unburnt molecules are heated by collision before they are burnt. I have then calculated at what pace a sound-wave would travel through such a heated mixture of gases, and found an extraordinarily close agreement between the rates so calculated and the velocities of explosion measured by the chronograph in a long tube.

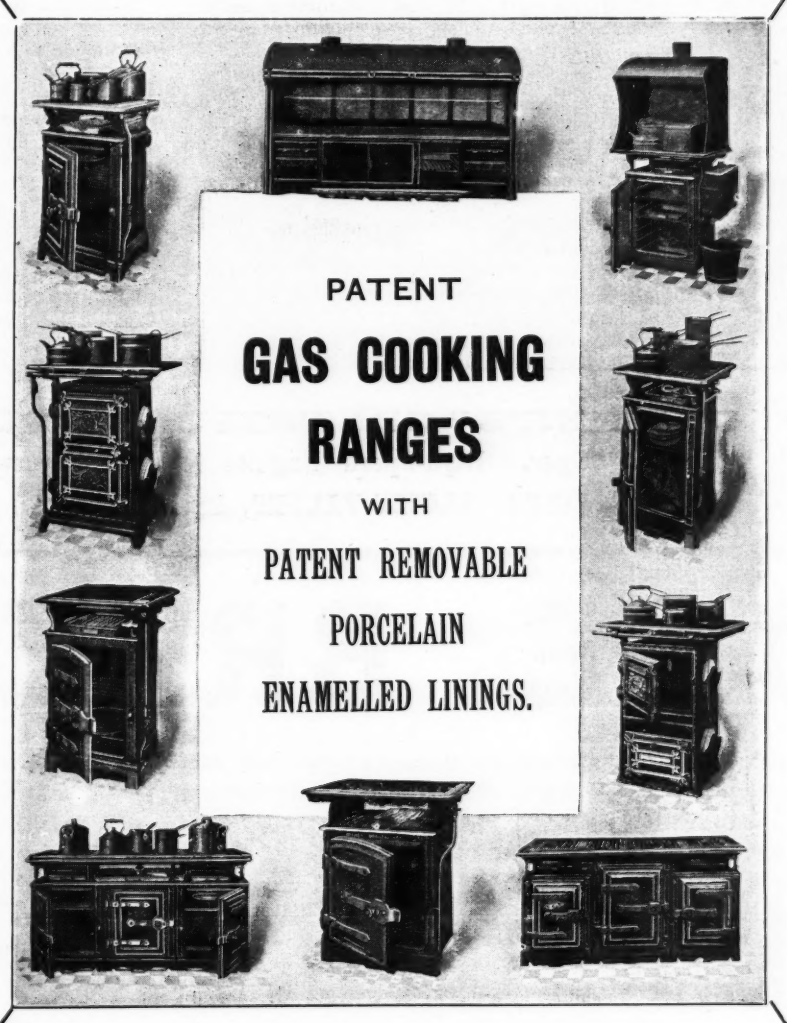
I have particularly studied the "damping" effect of inert gases on the propagation of the wave. I find the retarding effect to vary directly with the volume and density of the inert gas added. Conversely, I argue that if a gas added to an explosive mixture retards the wave by an amount which varies directly with its volume and density, then such added gas is inert so far as the primary action in the wave-front is concerned; and if it is found to be chemically altered, then such change is due to a secondary reaction taking place behind the wave-front. As an illustration of this work, I will refer to the rates of explosion of cyanogen with oxygen alone and when diluted—

$$\underset{2728}{C_2N_2 + O_2} \qquad \underset{2321}{C_2N_2 + 2O_2} \qquad \underset{2110}{C_2N_2 + 3O_2}$$

$$\underset{2398}{C_2N_2 + O_2 + N_2} \qquad \underset{2165}{C_2N_2 + O_2 + 2N_2}$$

Cyanogen mixed with its own volume of oxygen burns to carbonic oxide and nitrogen. The rate at which the flame is propagated is far higher than when two volumes of oxygen are used and the final products are carbonic acid and nitrogen. This is an argument in favour of the view that the carbon burns directly to carbonic oxide in the wave-front.

FLETCHER, RUSSELL, & Co. LTD.



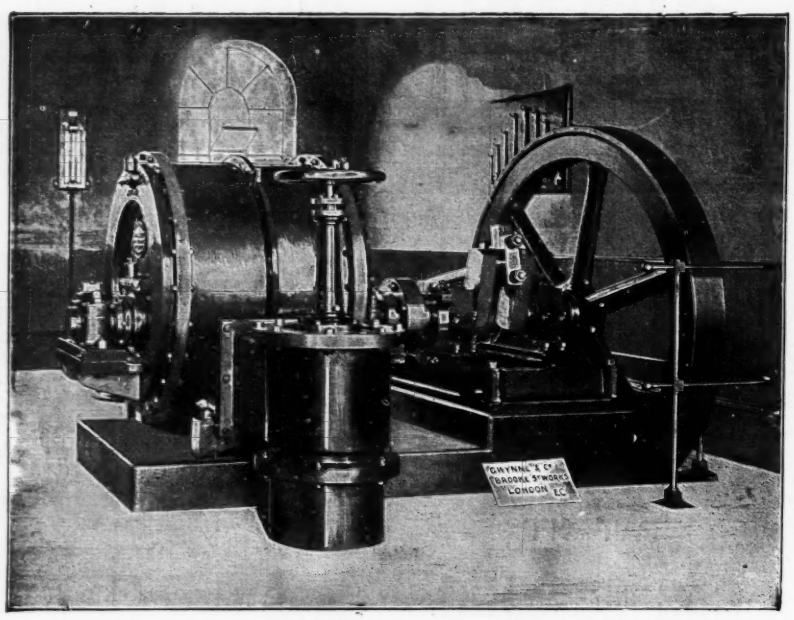
SHOW-ROOMS: { *134, Queen Victoria Street, LONDON, E.C.*
130 & 132, Deansgate, MANCHESTER.

WARRINGTON, MANCHESTER, & LONDON.

GWYNNES LTD.,

(J. & H. GWYNNE, Ltd., & GWYNNE & CO., United.)

81, CANNON STREET, LONDON, E.C.,
AND
HAMMERSMITH IRON-WORKS, W.



Telegrams: "GWYNNE, LONDON."

Telephone 544 BANK.

Gas-Exhausters

(GWYNNE & BEALE'S SYSTEM)

for all capacities from 3000 to 500,000 cubic feet per hour. Driven by Steam, Gas, or Oil Engines.

These Exhausters can be made, when desired, on our Patent Principle, to pass Gas without the slightest oscillation or variation in pressure.

Most of the principal Gas Companies and Corporations in this Country and Abroad have been supplied with these Machines, which are giving unqualified satisfaction in their work.

Write for full Particulars.

Also Makers of "GWYNNE'S" CENTRIFUGAL PUMPS of the "INVINCIBLE" and other Types. High-Speed Engines for all purposes. "GIRARDS" TURBINES. SLUICE-VALVES, &c., &c.

COKE BREEZE

Can be satisfactorily removed by Screens; but by using Little's Conveyors for carrying away the Coke from Retorts, the only Breeze to be handled is that which is inseparable from all systems of carbonizing. This can usually be burned under the Boiler, so very little need be put into the

INCLINED RETORTS.

Breeze is the bugbear of all Gas Engineers, as every cwt. handled is not only a loss in value, but represents wear on the plant.

OUR SPECIALITIES:	**OUR AIM:**
COKE CONVEYORS.	NO SUPERFLUOUS BREEZE.
COAL CONVEYORS.	LONG LIFE.
INCLINED RETORTS.	RESULTS BETTER THAN HORIZONTALS.
SHALLOW INCLINES.	LOW COST—WITH EFFICIENCY.

NEW CONVEYOR Co., LTD., SMETHWICK.

Stronger evidence on this point is obtained by comparing the explosion rate of these gases (1) when fired with oxygen sufficient to burn the carbon in them to carbonic acid, and (2) when nitrogen is substituted for the oxygen in excess of that required to burn the carbon to carbonic oxide. Oxygen added to electrolytic gas hinders the explosion more than nitrogen. In precisely the same way oxygen added to a mixture of equal volumes of cyanogen and oxygen hinders the explosion more than the same volume of nitrogen. The conclusion we must come to is that the oxygen added to the mixture expressed by the formula $C_2N_2 + O_2$ is as inert (so far as the propagation of the explosion-wave is concerned) as oxygen added to the mixture expressed by the formula $H_2 + O$. The same phenomena occur in the explosion of marsh gas, ethylene, and acetylene. In all these cases the substitution of nitrogen for the oxygen required to burn the carbon from carbonic oxide to carbonic acid increases the velocity of the explosion. These facts seem only consistent with the view that the carbon burns directly to carbonic oxide, and the formation of carbonic acid is an after occurrence.

I will not attempt to discuss the many difficulties that may be raised to my sound-wave formula for the propagation of the explosion-wave. I do not believe that the formula can be exact, for it presupposes a knowledge of the specific heats of gases at very high temperatures, and assumes that the reaction is complete at the moment of the passage of the wave. Possibly, the errors nearly neutralize one another. At all events, the formula has predicted results which have been found uncommonly near the truth. Compare for a moment the following rates, in metres per second, calculated and found for very different mixtures of gases :—

Mixture.	Calculated Rate.	Found Rate.
$8\ H_2 + O_2$	3554	3535
$H_2 + 3\ O_2$	1740	1712
$2\ H_2 + Cl_2$	1832	1849
$C_2N_2 + O_2$	2725	2728
$C_2N_2 + O_2 + 2\ N_2$	2166	2163
$C_2H_4 + 2\ O_2 + 8\ N_2$	1727	1734

In making the calculation given above for the hydrogen and oxygen mixtures, I have taken into account the decomposition of the oxygen molecule. If the change is determined on simple collision of the molecules, we must assume in the explosion of electrolytic gas that an oxygen atom is liberated—

$$H_2 + O_2 = H_2O + O$$

The wave will then be propagated partly by the burnt gas (steam), partly by half-burnt gas (steam, hydrogen, and atomic oxygen), and partly by the unburnt gas (hydrogen and oxygen). The mean density of this mixture of gases would be seven, referred to hydrogen.

Now, it is almost inconceivable that the rates of explosion could be given by any one formula for such very different mixtures of gases, unless the mode of propagation were similar in each case. I cannot imagine how this could happen, if we suppose with Armstrong that in each case there is formed a different series of intermediate "compatible compounds" which in turn break down. Again, the fact that heavy inert gases damp down the explosion-wave, just as they do a sound-wave, seems to me a strong argument that the explosion-wave and the sound-wave are propagated in the same way. In the one case of explosion where the chemical change seems to be direct—viz., the explosion of moist carbonic oxide and oxygen—the sound-wave formula does not apply. The rate of explosion increases with the addition of steam till the latter constitutes more than 5 per cent. of the mixture. In the case of other explosions, where the sound-wave formula does apply—viz., with hydrogen and oxygen, hydrogen and chlorine, cyanogen and oxygen, &c.—adding 2 per cent. of steam appreciably diminishes the rate. I see in these facts strong reasons to doubt whether Armstrong's theory can be applied to explosions.

Photographic Analysis of Explosion Flames.

The discovery of the detonation-wave in gaseous mixtures by Berthelot was followed shortly afterwards by the researches of Le Chatelier on the initial phases of the explosion. The method he found most suitable for tracing the progress of the flame was a photographic one; the movement of the flame along a vertical tube being recorded on a sensitized paper moving horizontally. Failing to obtain any photographic image of the flame with mixtures such as carbonic oxide with oxygen, Le Chatelier employed carbon disulphide with oxygen or nitric oxide; these mixtures yielding highly actinic flames.

When the gases were ignited by a flame at the open end of a long tube, the flame was propagated along the tube for some distance with a uniform slow velocity which Mallard and Le Chatelier regard as the true rate of propagation by conduction. In the case of mixtures of carbon disulphide with nitric oxide, this period of uniform movement is succeeded by oscillations of the flame, which sometimes become of larger and larger amplitude and then die down, and sometimes give rise to the detonation-wave. When carbon disulphide is mixed with oxygen, the preliminary period of uniform movement is shorter, and is immediately succeeded by the detonation-wave. These two mixtures appear to be typical of other gaseous mixtures—carbon disulphide with oxygen resembling oxygen mixtures generally, and carbon disulphide with nitric oxide resembling air mixtures generally.

Oettingen and Gernet set out to prove the truth of Bunsen's principle of successive partial explosions. By an ingenious arrangement, they contrived to pass a spark through a eudiometer tube at the moment when the image of the tube was thrown by a rotating mirror into a camera, so that the light of the flame might be drawn out and its movements recorded on a photographic plate. But though the flame of electrolytic gas appeared intensely bright, its spectrum only gave the sodium and calcium lines, and the most sensitive photographic plates showed "hardly a trace of the process." Failing to photograph the flame itself, they added finely-divided salts to the tube, and found that the most brilliant pictures were given by cuprous chloride.

The pictures show the passage of waves sharply reflected backwards and forwards from the ends of the tube, and gradually diminishing in intensity and velocity. These visible waves, according to Oettingen, are not a picture of the process of combustion itself, but are compression-waves moving through the products of combustion after the explosion is completed. The small metallic particles suspended in the heated steam are shining by the heat conferred on them by the hotter but invisible steam.

> "As little sparkles shine more bright
> Than glowing coals that give them light."

The explosion itself, he says, is quite invisible.

Fig. 1 (p.750) is a reproduction of their picture, showing the waves produced when the electrolytic gas is fired in the middle of a eudiometer 400 mm. long. The image of the spark is lengthened into a vertical line by reflection from the sides of the eudiometer. Nothing else is visible on the plate for some time, except a thin wavy line, which, according to Oettingen, is due to the particles of salt raised to incandescence by the spark. Then, after the lapse of 1-1000th second, the material in the tube becomes luminous, and a wave is seen starting from the upper end of the tube at *d* and traversing the gases to the lower end, where it is reflected at *e*, and so on backwards and forwards, making nearly four complete vibrations before it becomes non-luminous. The photograph shows very beautifully the passage of these compression waves through the heated gases; but I can see no evidence therein for the conclusion drawn by Oettingen—viz., that a true detonation-wave has proceeded from the spark, and its compression-wave has traversed the tube several times before it becomes visible by raising the salts to incandescence. Fig. 1A (reproduced from their memoir) shows in outline the course of one of these hypothetical waves starting downwards from the spark and being reflected at *a*, *b*, *c*, and *d* before it becomes visible.

In the next photograph reproduced (fig. 2), the gases were fired at a point a quarter of its length from the bottom of the tube. In this case, there is a displacement of the wavy line joining the spark to the luminous portion, but hardly sufficient to justify the conclusion that the visible wave proceeding downwards from *d* is the residue of a detonation-wave starting upwards from the spark, and being reflected at *b* and again at *c*. I will show directly that the interpretation put upon these photographs by Oettingen is erroneous. The flame really starts slowly, but its rate of progress is remarkably affected when it is reflected from the end of a tube. It is quite true that the flame of electrolytic gas when first ignited has very slight luminosity; but this only holds during the period of slow motion.

Besides these primary waves, however, there are others

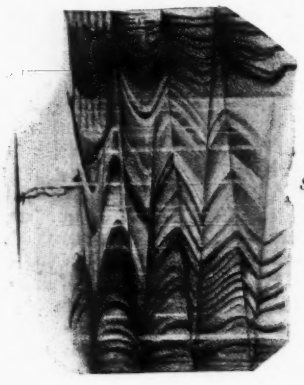


FIG. 1.

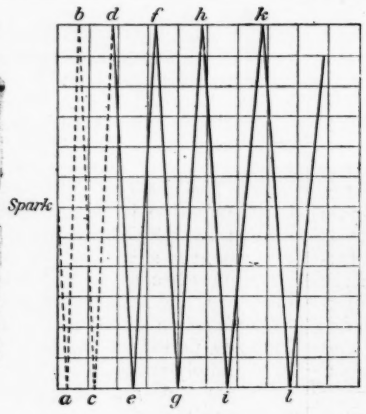


FIG. 1A.

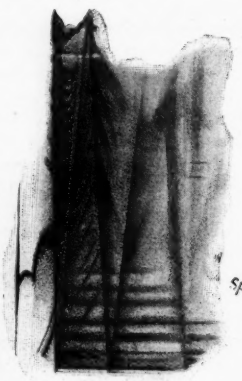


FIG. 2.

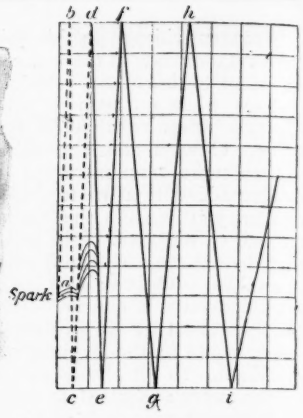


FIG 2A.

to which Oettingen and Gernet call special attention. These are the "secondary waves" running nearly parallel to the primary waves. The photograph given in fig. 1 is referred to as showing very clearly four of these waves near together running parallel to the chief wave, which starts downwards

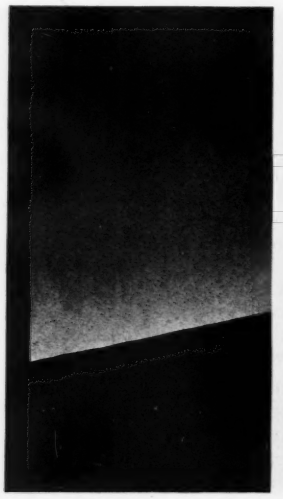


FIG. 3.

FIG. 4.

from *d*. Other photographs show somewhat similar appearances—*i.e.*, of weaker waves running nearly parallel to, and sometimes coalescing with, primary waves. Oettingen and Gernet say that they can find no other reason for these waves following one another at a short interval but this—that successive explosions have taken place from the electrodes, exactly as Bunsen imagined. The evidence relied

FIG. 5.

FIG. 6.

upon for these successive explosions appears to me exceedingly slender. My own photographs will show how complicated the reflections are when gases are exploded in a short tube, and how readily "nearly parallel waves" are produced with a single ignition of the gases. In the many photographs of the initial period of the explosion taken by me

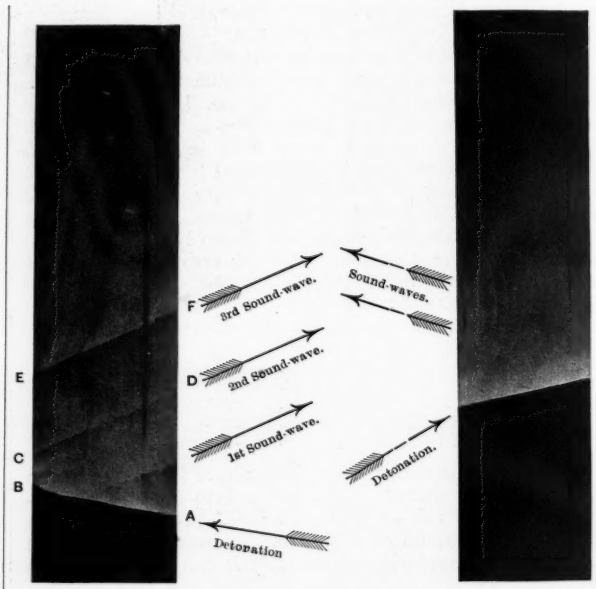


FIG. 7.

FIG. 8.

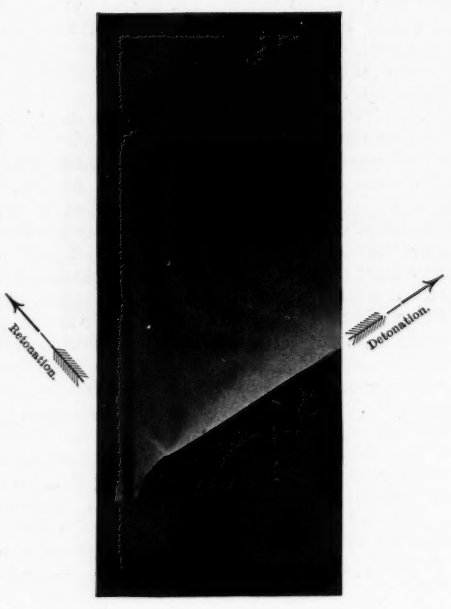


FIG. 9.

FIG. 10.

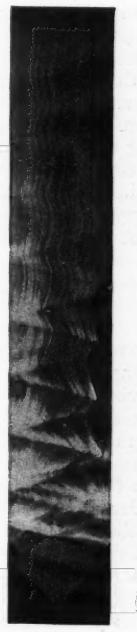


FIG. 11.

FIG. 13.

FIG. 14.

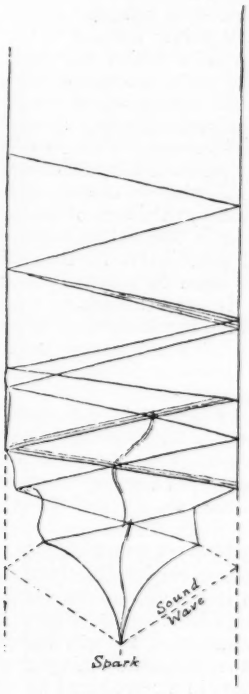


FIG. 11A.

FIG. 12.

FIG. 15.

FIG. 16.

FIG. 17.

and my fellow-workers, there is no indication of any second flame starting from the region of the spark.

In 1895, I began a photographic analysis of the flame produced by the explosion of cyanogen with oxygen, and found that the flame could be sharply photographed on Eastman's films without the addition of any metallic salts, and that the films could be rotated very rapidly on a wheel without damage. The camera and film being arranged so that the image was thrown on the film as the latter moved vertically downwards, and the explosion-tube being fixed horizontally, the photograph showed an inclined line of light compounded of the horizontal movement of the image of the flame and the vertical movement of the film. When the explosion-tube was placed at such a distance from the camera that the length of the image was 1-30th that of the tube, a velocity of the flame of 3000 metres per second corresponded with a horizontal velocity of the image of 100 metres per second. When the wheel was rotated 25 times per second, this caused the film to move vertically at a rate of 25 metres per second—the circumference of the wheel being 1 metre. The line described by the image on the film thus made an angle with the horizontal, whose tangent was one quarter (nearly 14°); or, when the wheel was rotated at twice this velocity (50 metres per second), the angle was nearly 27°. For most experiments, a rate of rotation between these limits was used, though the wheel could be rotated from 80 to 100 times per second.

The true velocity of the wheel was determined by the trace of a tuning-fork, which showed that several revolutions were made at a sensibly uniform speed, and therefore that the speed of the film might be taken as rigorously uniform during its movement through the small arc affected by the photograph. Some thin strips of black paper were fastened round the explosion-tube, to give reference marks on the

photograph. These strips appear as black vertical bands on the prints, and are useful for measuring the angles made by the detonation or reflected waves.

The first points noticed in the photographs were (1) the sharpness with which the luminosity was set up, (2) the uniformity of the detonation-wave. There is no evidence of any gradual heating-up of the gases; but, on the contrary, the temperature appears to spring to its maximum with abrupt suddenness. This is, of course, in accordance with the views published by Berthelot and by myself as to the character of the detonation-wave, which we believe to be propagated by the shock of the molecules themselves moving forward with the velocity due to the whole heat of the chemical combination. But this sharpness of beginning does not seem to me to be compatible with Armstrong's theory. If the oxidation of cyanogen or of ethylene is a gradual one, involving several successive stages, we should expect to find a progressive brightening in the photographic image. There is no preliminary combustion which affects a photographic film.

The gas ignited by the detonation-wave (including dust and particles knocked off the tubes) remains luminous for some time after the wave has passed. As had been anticipated, cyanogen burning to carbonic acid left a longer trail of light than when it was burnt to carbonic oxide only, and the most prolonged images were obtained with the two mixtures $C_2N_2 + 2\ O_2$ and $CS_2 + 3\ O_2$. Many of the photographs show very distinctly the movements of the gas *en masse*, as it follows up the detonation-wave, comes to rest, and swings back again. Fig. 3 (taken in a long tube) shows the movements of the gas undisturbed by a reflected wave. These movements are analogous to the forward and backward movements in air produced by a vibrating body.

The next photographs reproduced show the reflection of the explosion-wave from the closed end of the tube. The wave itself, propagated in a mixture of cyanogen with two volumes of oxygen, is travelling from right to left at the bottom of each photograph. In fig. 4 the wave strikes the end of the tube (a metal stopper being used), and a reflected wave is thrown back. The dark band was 35 centimetres from the stopper. Fig. 5 shows the reflected wave between 35 and 70 centimetres from the closed end; and fig. 6 the reflected wave travelling between marks placed at 70 and 105 centimetres from the closed end.

Velocity of a Sound-Wave in the Flame of Exploded Gases.

The velocities of these reflected waves, which can be easily measured, afford an indication of the temperature of the gas through which they are propagated—if they travel as sound-waves. Now, the velocity of the reflection-waves in cyanogen exploded with its own volume of oxygen is 1230 metres per second. Assuming the specific heats to be unaltered by any rise of temperature, the temperature of the gas where the reflection-wave was measured is given by the formula—

$$T = \left\{ \left(\frac{v \sqrt{\frac{d_1}{d}}}{333} \right)^2 - 1 \right\} 273 = 3330^\circ \text{ C.},$$

where v is the velocity of sound and d_1 and d are the densities of the gas and air respectively under the same conditions. The velocity of the reflected wave in a mixture of cyanogen with two volumes of oxygen gave a temperature of 4200° C.

The interest attaching to the determination (even approximately) of the temperatures produced in the explosion of gases led me to attempt the measurement of the rate of a true sound-wave (of small displacement) in the gases produced by the detonation-wave. In my first experiments, a glass explosion-tube was fitted to a steel piece, containing a tap of large bore and a small bye-tap, and connected by a pipe to a steel bomb, in which a small charge of fulminate could be fired. The bomb and connecting-pipe were filled with air, while the glass was filled with a mixture of cyanogen with two volumes of oxygen. The lengths of the tube were so adjusted that the sound-wave started in the bomb by the detonation of the fulminate should be propagated through the air and cyanogen mixture, so as to meet the detonation-wave coming in the contrary direction before the latter reached the end of the glass tube. The detonation-wave was then photographed as it met the sound-wave, fig. 7.

The experiment was next varied by the introduction of a thin iron membrane between the air and the explosive mixture. The shock transmitted through the air from the fulminate struck the flexible plate, and so propagated a wave of small displacement through the explosive mixture. This wave had very little effect upon the movements of the gas in the wake of the detonation-wave, but its passage through the luminous gas was plainly marked. The gases were ignited as before; the lengths of the tubes being so adjusted that the first sound-wave met the detonation-wave about 1 metre from the membrane. Several of these sound-waves (produced by echo in the bomb) are seen in fig. 8 traversing the flame produced by the explosion of cyanogen with its own volume of oxygen. These sound-waves apparently increase in velocity owing to the movements of the gas through which they pass.

It is not very easy to measure the angles of these faintly-marked sound-waves; but three photographs have given as the mean of several independent measurements made on each photograph the velocity of the sound-wave *in the stationary gas* as 1250 metres per second. This velocity corresponds to a temperature of 3460°, which is a number in very fair agreement with that calculated from the reflection-waves—viz., 3330°. This agreement indicates that the reflection-waves really travel with a velocity approximately equal to that of sound.

The most important point connected with these measurements is the fact that the temperatures found are of the same order as those determined by Bunsen, Berthelot, and Le Chatelier. But the photographs plainly show that these sound-waves are travelling in the *burnt* gas, which is much less bright, and consequently at a lower temperature, than the explosion-wave itself. The "effective" pressures measured by Bunsen and the French chemists are the pressures maintained for some time in the burnt gas, and not the instantaneous pressures of the explosion-wave.

On the Initiation of the Explosion-Wave.

Photographs taken of the whole flame starting from the firing-wire show that the flame commences slowly, gathers pace and intensity, and finally sets up the explosion wave, which proceeds with a perfectly uniform rate and intensity. The explosion-wave starts suddenly, throwing back a wave that I call the wave of "retonation," and leaving a dark space of cooled gas at the point of starting. But when, as is usual, the gases are fired by wires sealed into a tube a few inches from one end, the flame which travels to the near end sends back a reflected wave, which travels through the ignited gas more quickly than the original flame. This second (reflected) wave may catch the primary flame and modify its motion and intensity. The rapidity of inflammation and the quickness with which the explosion-wave is set up largely depend upon the point of ignition, and whether the flame can get get this "kick-off" from the end of the tube. When the gas is fired *at the end*, the flame travels much more slowly. This is a point which I think deserves the attention of all who are designing internal-combustion gas-engines.

Now, when an explosive mixture in a tube is fired by a spark, the suddenly ignited gases must expand, and transmit a compression-wave in both directions. This travels with the velocity of sound in the unburnt gas, and will be reflected from the end of the tube. The propagation of the flame from the firing point is, in most gaseous mixtures, less rapid than the velocity of sound in the unburnt gas; but the rate of propagation of the flame augments much more rapidly in some mixtures than in others. If the tube is a long one, the flame would overtake the sound-wave after a more or less prolonged chase, according to the nature of the mixture. But if the tube is short, the sound-wave may reach the end of the tube, and return as a reflected wave to meet the flame which is still advancing. This seems to be the origin of the "return-wave," which crosses and checks the primary flame.

Fig. 9A gives in outline the movements of the flame in fig. 9. The flame, starting in the centre, moves to the right and left, tracing a curve. If a sound-wave in the unburnt gas had started at the same time as the flame, it would reach the two ends of the tube and be reflected before meeting the flame. On constructing the figure from the approximately-known velocities of the film and the flame, it is seen that the sound-wave meets the flame on each side at the spot where the movement of the flame is retarded and the "return wave" is visible—within the limits of experimental error.

The next photographs show the great influence exerted on the flame by these sound-waves. If the tube is of such a length that the flame overtakes the sound-wave before it reaches the end, these interferences are stopped. The simplest case is when the "detonation" (explosion-wave) and "retonation" waves coincide. The retonation-wave attains its greatest rapidity and brightness when it is developed at the closed end of a tube—*i.e.*, when the gas is fired at such a distance from the closed end that the explosion, gradually increasing in intensity, just reaches the detonation-point as it arrives at the stopper. Under such conditions, the reflected wave is superposed on the wave of retonation, and the result is a wave which cannot be distinguished from a true detonation. Fig. 10 shows the retonation-wave developed at the closed end of the tube in the mixture $C_2N_2 + 2O_2$. Fig. 11 shows the same mixture fired in a shorter tube. Here the sound-wave reaches the farther end, and is reflected on to the advancing flame, which is checked and modified by it. The third photograph shows the same mixture fired in the centre of the short tube. Reflected sound-waves return from both ends, and can be traced as they travel backwards and forwards in the burning gases.

These photographs also show how entirely erroneous is Oettingen's interpretation of his photographs. The true explosion is not invisible; the flame can be photographed throughout its whole course. But in the initial stages the flame travels slowly, and is of small intensity. It only becomes brilliant when the explosion-wave is set up, or when a retonation or powerful reflected wave traverses the burning gases. *In the initial stage, the combustion is taking place slowly; only a few among the total collisions occurring are chemically fruitful. In the detonation or explosion-wave, the combustion is taking place with intense rapidity; the great majority of collisions being chemically fruitful.*

The explosion-wave may be made to meet a flame in the initial stage. It can be seen to pass through the already-ignited gases with hardly any check on its velocity and intensity. It is perfectly evident, from this and from a study of the reflected waves, that combustion cannot be complete when these intense waves traverse the gases. *The spread of the flame is not synchronous with the attainment of maximum temperature or with complete combustion.* The reflection of the sound-waves through the burning gases give rise to many nearly parallel "secondary" waves. Their source can readily be traced on the photographs; there is no need to invoke any of Bunsen's "successive partial explosions" to account for them. My students and I are now trying to photograph the movements of flame in a gas engine cylinder, while the pressures are recorded by an indicator.

In conclusion, lest you should think this long discourse on the phenomena of explosions both wearisome and out of place, let me point out that the burning of a highly-explosive gas mixture is one of the best means of developing light from gas. Coal gas and air will not "detonate," but coal gas and oxygen will do so. Industrial (50 per cent.) oxygen can now be made fairly cheaply by the fractional distillation of liquid air. It has been made on the large scale at a cost of about 5s. per 1000 cubic feet; and I see no reason why it should not be manufactured for half this price. Coal gas fed with such oxygen may be made to burn on a zirconia mantle and give a light, roughly, of 200 candles for a consumption of 2 cubic feet of gas per hour. Is not this something which would have appeared chimerical a year or two ago? Yet it is only one of the developments which must flow from a study of the mechanism of combustion of gases.

The PRESIDENT, in proposing a vote of thanks to Professor Dixon, said all present must have been struck with the charming lucidity of the explanations which accompanied the experiments, and which had made matter of the most abstract scientific character so clear that everyone must carry away a distinct impression of the points that the lecturer wished to convey. Every point had gone home; and the whole discourse had been of the most profound interest. It was not of purely scientific interest, however; for, having shown them what went on in the flames with which they were more or less familiar, Professor Dixon had crowned it all by showing them how enormously gas-light might be intensified. If it were true that oxygen gas could be produced at 5s. per 1000 cubic feet, it would be an immense step, not only in the production of a superb light, but it could be employed more effectually still in connection with the use of gas as fuel and power. He felt that the lecture formed a most important step in the history of the Institution.

Dr. H. G. COLMAN, as an old student of Professor Dixon, said he had much pleasure in seconding the motion. He need not repeat what the President had said as to the interest with which they had all listened to the lecture; but when they heard so many important results narrated in the space of an hour, they perhaps hardly realized the immense amount of time and research which they represented, mainly on the part of Professor Dixon himself. They had heard the results of some thirty years' work, a great portion of which had been carried out at considerable personal risk; for he (Dr. Colman) had still a very vivid recollection of a rather serious explosion which occurred on one occasion, though, happily, no one was injured.

The motion having been carried unanimously,

Professor DIXON, in response, said it had been a great pleasure to him to come among the members of the Institution; and he hoped that some advantage would be gained—on his own part, at any rate; for the nearer men of science were brought into contact with practical men, and knew what they were doing, the better it was for both, and certainly for the men of science. However lucid he may have been, he might say that he had left out a great deal that he wanted to say, because he found it impossible to condense it all into an hour; but further details would be found in his lecture when printed. Professor Dixon went on to explain one of the points he had omitted, arising out of the rates of propagation of explosions, and the bearing it had on his own and Professor Armstrong's theories. He pointed out that if his theory were correct, a formula could be found which would express the reactions in different gases and mixtures; whereas upon Professor Armstrong's theory, this would be impossible. The details would be found in the lecture.

PAPERS READ.

TEN YEARS' EXPERIENCE WITH THE PREPAYMENT METER.

By ALFRED COLSON, of Leicester.

It has recently been stated by the chief official of a large provincial gas undertaking that "the slot meter system is always unsatisfactory and involves a considerable amount of loss." As this is entirely contrary to the writer's experience, particulars of the prepayment system as adopted in Leicester, together with the results obtained therefrom, may be of some service to those who are still doubtful as to the wisdom of its introduction.

It was in 1894 that prepayment meters were introduced into Leicester, when 344 were fixed; the ordinary meters at that time numbering 25,819. Five years later, the slot meters numbered 12,011, and the ordinary 27,439. At the end of 1903, 26,068 slots were in use, in addition to 25,706 ordinaries. Since 1899, slot meters have increased by 14,057; while ordinary meters have decreased 1733. For the nine years previous to 1894—the year of the introduction of these meters—the books show an increase of 5599 consumers, or an annual average of 622; while for the nine years since 1894, there is an increase of 25,611 consumers, or an average of 2845 per annum. The total number of consumers is now 52,090, of whom 25,451 use ordinary and 26,639 prepayment meters. Although by the end of 1897 the number of meters in use was 5624, it was not until cooking stoves were supplied and fixed free of charge, in 1898, and a systematic canvassing of non-consumers undertaken, that the rapid increase was noticeable.

The five years following this change of policy showed an increase of 17,428. The direct orders through canvassing exceeded 7000—all from previous non-consumers; and this number does not include those taken at the town offices. The author has no hesitation in saying that more than 10,000 of his present consumers would not have been on the books had not the prepayment system been adopted. Proving how general is the use of the cooking stove with this meter, the returns show that of the 26,068 meters fixed at the end of 1903, no less than 25,318, or 97 per cent. had stoves in connection with them. With the meter is supplied a main tap and connection, and the necessary stove supply

pipe, but nothing in the way of other fittings, such as pendants, brackets, burners, &c. The selection of the make of meters to be adopted should receive the most careful consideration, both with regard to accurate working and cost of repairs and maintenance. The following tables show the result of experience at Leicester with the various meters tried:—

Prepayment Meters—Wets.

Maintenance, 1894 to 1903.

Maker.	Total Received.	Average Age in Years.	Percentage of Repairs per Annum.
A	3956	5·8	3·1
B	6270	6·2	4·3
C	2514	5·6	5·5
F	228	5·7	6·2
D	2833	5·3	7·7
G	228	8·0	22 0
J	112	7·0	33·2

Prepayment Meters—Drys.

Maintenance, 1901 to 1903.

Maker.	Total Received.	Average Age in Years.	Percentage of Repairs per Annum.
D	2317	2·0	1 3
B	2614	2·3	1·6
E	1810	2·1	1·9
A	2356	2·2	1·9
G	168	1·3	2·2
C	1764	2·1	2·5

There is nothing of greater importance in connection with this system than that of inspection and collection. The working of the meters should be closely watched, and the inspections and collections regularly made and carefully checked. A sharp look-out should be kept for unoccupied houses, and the meters quickly removed therefrom. The inspectors should be most trustworthy and properly supervised, and their daily reports carefully studied and acted upon. At the present time at Leicester, 25 inspectors are employed under a chief inspector in connection with the work—the inspection and collection being continuous. Each meter is visited twice quarterly. The inspectors leave the town offices soon after 9 o'clock in the morning; each being provided with a leather hand-bag, which is changed twice daily at previously arranged times and places. At such times and places, a special inspector is in attendance with a conveyance for the purpose of collecting the full bags and taking them to the offices. At 5 p.m. the inspectors return to the offices and pay over to the chief inspector the cash received during the day, done up in 5s. packets, which are in their turn placed in £5 canvas bags. As a precaution, the money is weighed as well as counted. With his money each inspector hands in a sheet showing the separate amounts collected. These sheets are carefully checked in the rental office next morning, and the entries compared with the inspection books. Any discrepancy between meter registration and money is noted; and if the amount of excess or shortage exceeds 2d., a reinspection is made, and, if necessary, the meter at once changed. The total amount of each inspector's day-sheet is entered into a cash book, and the total sum of the cash book appears monthly in the gas rental, with an equivalent quantity of gas reckoned out at the price per 1000 cubic feet. All money is banked the morning following the collection. The present ordinary charge for gas at Leicester is 2s. 4d. per 1000 cubic feet; the prepayment rate being 30 feet for 1d., equal to 2s. 9⅓d. per 1000 feet.

The following particulars relate to the organization and duties of the staff employed:—

1 chief inspector, who supervises the whole of the work, reporting to the engineer and manager daily.
17 inspecting and collecting.
2 on "outs" (consumers not at home at ordinary inspection).
2 on "specials" (consumers leaving, and complaints).
1 re-inspecting for "differences," &c.
1 finding, inspecting, and collecting cash from empty houses, a list of many of which is supplied by the police.
1 checking other inspectors' work; the one employed being changed every week, so that each man takes his turn at this work.
1 arranging for, and collecting, the full cash bags, and making special calls.

The number of inspections and collections made daily by the men on ordinary work varies from about 60 at the quarterly inspection to (say) 40 at the half-quarterly, when wet meters are water-lined and drys tested for registration. The inspectors are paid £2 per week maximum, and are supplied with winter and summer uniforms. The special care taken in connection with the inspection and collection necessarily adds to the cost at this point, but greatly reduces future labour and clerical work.

Referring to the following tables, the first shows the number of prepayment meters fixed, and stoves in connection with them, at the end of each year, with the gas consumption; the second (which relates to last year), the quantity of gas taken by the prepayment meters compared with that used for other purposes; and the third, the quarterly consumption through prepayment meters compared with the total consumption for the year 1903.

TABLE I.

Number of Prepayment Meters fixed at End of each Year, and Stoves in Connection with Them, with the Gas Consumption and Amount of Coppers collected.

Year.	Prepayment Meters fixed to Date.	Cooking Stoves fixed free in connection with pp. meters.	Gas Consumed. Cubic Feet.	Per cent. of Total Gas Consumption. C. Ft.	Average Yearly Consumption per Meter.	Amount of Coppers collected.
						£ s. d.
1894 (½ year)	344	—	1,128,700	—	—	188 2 4
1895 . . .	594	—	4,302,100	0·35	10,570	717 0 7
1896 . . .	2,174	—	12,467,100	1·0	11,828	1,757 11 9
1897 . . .	5,624	—	41,841,800	3·0	10,693	5,488 4 10
1898 . . .	8,640	1,024	79,525,400	5·5	11,409	10,935 12 8
1899 . . .	12,011	7,872	143,014,800	9·0	13,963	19,671 16 10
1900 . . .	16,168	13,001	216,367,400	13·0	15,029	31,225 2 1
1901 . . .	20,150	18,180	285,532,000	17·0	15,383	42,291 12 1
1902 . . .	23,471	22,978	339,170,200	19·0	14,971	47,377 10 4
1903 . . .	26,068	25,318	402,178,800	22·0	16,137	56,191 11 9

Detailed Particulars of Coppers Collected during the Year 1903.

—	—	No. of Coins.	Weight.
	£ s. d.		Tons. cwt.
Total amount collected in 1903 . .	56,191 11 9	13,485,981	125 8
Average amount collected daily .	202 17 2	48,686	9
Greatest total for one day. . . .	415 16 5	99,797	18½
Greatest total for one collector for one day	25 11 10	6,142	1 cwt. 16 lbs.

TABLE II.

Gas Sold during the Year 1903.

	Cubic Feet.	Per Cent. of Total Consumption.
Through ordinary meters . . .	1,101,974,000	.. 60
Through prepayment meters . .	402,178,800	.. 22
For engines	235,979,700	.. 13
For public lighting	93,595,949	.. 5
Total . . .	1,833,728,449	

TABLE III.

Comparison of the Quarterly Consumption of Gas through Prepayment Meters, with Total Gas consumed for all Purposes, for the Year 1903—*viz.*, 1,833,728,449 *Cubic Feet.*

Quarter.	Consumption through Prepayment Meters. Cubic Feet.	Per Cent. of Total Consumption.
Lady Day	105,136,000	.. 19
Midsummer	79,070,700	.. 22
Michaelmas	107,765,800	.. 28
Christmas	110,206,300	.. 19
Total . . .	402,178,800	.. 22

Average: { Summer quarters . 25 per cent. of total consumption. Winter quarters . 19 per cent. of total consumption.

The special points to which the writer would direct attention are: The great increase in the number of meters fixed since stoves were supplied free; the steady advance in the

percentage of gas consumed through prepayments compared with the total consumption; and the increase in the annual consumption per meter from 10,570 cubic feet in 1895 to 13,963 feet in 1899 (after the introduction of free cookers) and 16,137 feet for last year. Admitted that the prepayment system offers greater facilities to the poorer classes, and induces many to burn gas who would not otherwise do so, it may be asked, What, looking at the matter from a purely business point of view, is the gain to the gas undertaking adopting it? As regards Leicester, the following statement, worked out from actual figures, shows the extra cost and return per consumer per annum, as well as per 1000 cubic feet.

PREPAYMENT CONSUMERS.

Extra Cost per Annum.

		Per Consumer. s. d.	Per 1000 Cubic Feet. d.
Extra cost of meter, 17s. 3d.	5 per cent.	10·35	0·65
Upkeep on ditto	7½ ,,	1 3·52	0·97
Cooking-stove (10 per cent. on cost), supplied rent free		3 0	2·25
Cost of fitting up stove, &c. (fittings, 10s. 6d.; meter connections, 3s. 6d.), 14s.	5 ,,	8·40	0·52
Upkeep on ditto	5 ,,	8·40	0·52
Additional cost of each inspection, 1·16d. × 8 inspections per annum		9·28	0·58
Extra cost through more frequent changing and fetching of meter		3·23	0·20
Differences, including thefts		2·52	0·16
Conveyance of coppers		1·00	0·06
		7 10·70	5·91

Special Gain per Annum.

Average consumption of gas, 16,000 cubic feet per annum at 5·33d., the difference between the ordinary price (2s. 4d.) and prepayment price (30 feet for 1d. = 2s. 9 33d.)	7 1·28	5·33

PREPAYMENT CONSUMERS.

General Gain to the Department.

10,000 consumers who would not otherwise burn gas, each burning 16,000 cubic feet per annum.
Increased day and summer consumption.
Bank interest.
Saving on—
  Office accommodation.
  Office staff (clerical work).
  Collection of accounts.
  Printing and stationery.

It will be noticed that on a prepayment meter 5 per cent. is charged upon the extra cost for interest, and 7½ per cent. for upkeep. This latter item is ample, being in excess of the actual cost so far. The average cost of the cooking stove supplied is 30s.; and 10 per cent. is charged on this for maintenance and renewals. Upon an average cost of 10s. 6d. for stove fitting and 3s. 6d. for meter connection, 10 per cent. interest and upkeep is charged. The additional cost of inspecting and collecting over ordinary inspection works out at 1·16d., or 9·28d. for eight inspections per annum. Then it is taken into account that, with the necessarily more frequent change in tenancy, and meters being promptly dealt with and quickly removed from empty houses, an extra cost is entailed. This averages 3·23d. per consumer. Differences (including thefts, which, notwithstanding the utmost care and watchfulness, cannot altogether at present be avoided) average 2·52d., and the cost of conveyances for the carriage of the coppers 1d., per consumer. The total extra cost of each prepayment consumer works out at 7s. 10·70d. per annum, or 5·91d. per 1000 cubic feet of gas consumed through these meters.

On the other side, there is, as special gain—the extra price of 5·33d. per 1000 feet, which, calculated on the average consumption of gas per annum for the year 1903, represents 7s. 1·28d. per consumer. These figures show a loss per consumer of 9·42d. or 0·58d. per 1000 cubic feet; but against this there is: The general gain to the department through the profit on the consumption by the 10,000 consumers, who would not otherwise have taken gas; the great advantage of the increased day and summer consumption; and interest gained or saved through the bank balance, and the saving in clerical work, collecting, printing, and stationery, and cost of office accommodation. These are all items of importance; and while it is, of course, impossible to state in definite figures what actual saving or gain is represented, it must certainly be more than sufficient to cover the amount shown in the table as loss.

While the experience at Leicester proves conclusively the advantage of the prepayment meter system, both to the department and to the consumers, it should not be necessarily concluded that the same difference in the price of gas—viz., 5·33d. per 1000 cubic feet—would be sufficient to cover all additional costs in other towns. So much depends upon local circumstances, what fittings are supplied free, and to what extent the system meets with the support of the public, that every case must be dealt with on its merits.

In the preparation of this paper, the author gladly acknowledges the help he has received from two of his Assistants, Mr. Lovell and Mr. Pingriff.

Discussion.

The PRESIDENT said the statistics that Mr. Colson had collated so carefully were of the greatest use, and would be valuable for comparison with the work of other members. If they could enrich the discussion by the addition of any further figures from gentlemen present, which might contrast with or confirm those now given, he hoped they would be forthcoming.

Mr. G. HELPS (Nuneaton) said this was the first occasion on which he could agree with a paper which, on the face of it, appeared to be contrary to the ideas he had expressed in the past. Mr. Colson had shown an immense amount of forethought in connection with this matter; and his results were very valuable. From his own understanding of the system, he (Mr. Helps) had always taken it to mean the free supply of meter and fittings to the consumers; and he was interested to find that Mr. Colson did not do this. He supplied a main tap and the connections necessary, with a stove supply-pipe, but nothing of the other fittings; and it was these that, in his opinion, had caused all the trouble with the slot-meter system. When by the use of these meters a consumption of 16,000 cubic feet per meter per annum was obtained, surely there could be no doubt about its advantage. The extra price was 5d. for the rent of the meter and stove; and there were 52,000 consumers and 25,000 cookers. From this there was to be taken only the cost of the meter and of half the stove to each consumer—something like 15s., as it was said they cost about 30s. So that it was impossible to go wrong—in fact, the paper showed in every passage that the system was an undoubted success. Every charge seemed to have been covered fully, though in many places where they supplied fittings free, they had to charge 10d. per 1000 cubic feet extra. There were very few gas undertakings he had heard of where they got such a result as 16,000 cubic feet per consumer. He thought the paper was likely to do more good in the direction of stopping the wild introduction of fittings in connection with prepayment meters than any he had heard.

Mr. C. STAFFORD ELLERY (Bath) could congratulate Mr. Colson on his wonderful success with the prepayment system. He thought they were doing fairly well when they had a consumption of 14,000 or 15,000 cubic feet per consumer; but Mr. Colson seemed to have done rather better. As representing one of the towns which had been guilty of the wild system of supplying fittings as well as stoves, he felt that it needed some courage to stand up immediately after the last speaker; but as he believed there were conditions in towns where the slot-meter system could never succeed without the company assisting by introducing pipes, he felt that it would not do to be silent after such scathing criticism. There were one or two points, on which perhaps he might be allowed to say a word, which were not touched upon in the paper, and on which he would like to hear Mr. Colson's opinion after his long experience. He had not told them the size of the meters they supplied.

Mr. COLSON: They are 5-light meters.

Mr. ELLERY said it was rather late for him to begin using 5-light meters, as they had so many 3-lights at work, and he hesitated about commencing the use of a larger meter. But for those who might be starting the slot system, he certainly thought it was well worth consideration what sized meter should be put in. He did not know how many burners Mr. Colson permitted the consumer to have connected with the meter; but he believed that they often ran now to four or five, or even more, and when they happened to be using gas with three burners, or when the stove was at work with two or three burners also in use, some meters were taxed to such an extent that the consumption was not correctly registered. This might have something to do with the large cost of repairs and the short life to which Mr. Colson had referred. The capacity of slot meters by different makers had rather

startled him (Mr. Ellery) lately in some tests which had been made as to the quantity of gas that a given meter would pass per hour and yet register correctly. He thought this point was worth some investigation before anyone embarked on a particular meter for use with the prepayment system. As to the extra charge of 5⅛d. beyond the average price, he should like to know if a rental was put on for ordinary stoves, and also whether they charged meter-rent.

Mr. COLSON said they charged for the stoves, but not for the meters.

Mr. ELLERY said this removed any difficulty. Where rental for ordinary meters was charged, this must be taken into account. He thought those who supplied the meter, stove, piping, and all the fittings, could not charge less than 10d. per 1000 cubic feet extra to cover all the expenses of an installation in a house where gas had not been used before, and where it had to be fitted up entirely. In most towns they were able to take over a number of consumers in whose houses there were already gas-pipes, and where it was only necessary to provide brackets, pendants, and so on. But, taking one case with another, £4 to £5 must be put down as the capital amount to be expended on such an installation. Another item was the interest on the cost of the cooking-stove. He did not know whether the 10 per cent. was sufficient to pay for interest on the outlay as well as for depreciation of the stove. But the manner in which some of these articles were treated rather indicated that the life of the stove would not be very long; and it seemed to him that 10 per cent. was rather low to cover both interest and depreciation—a point which might be of some importance. He should like to confirm what looked rather singular—that the Michaelmas quarter was the heaviest. This was probably accounted for by the fact that in the summer months the stoves were more largely used. They had lately had at Bath some striking experience with another charge which he thought must be faced in connection with slot installations—namely, the cost of mains. It used to be the practice to take the pressures on a Saturday night, and see when the mains were being taxed; he now found that the proper time was between twelve and one on Sunday. To give an illustration, in a district about seven miles out of the city they had fixed for some twelve months a register to indicate the continuous pressure, and to ascertain what was going on in the district; and the diagram at the works showed that, in order to maintain the correct pressure seven miles from the works, between twelve and one on Sunday there was a peak very considerably higher than any for the night consumption. Indeed, the mains were now so taxed that others (to the extent of some miles) would have to be laid in this particular district simply on account of the slot consumers. Therefore, in estimating the cost of this particular system, and considering the advantages which might result from its introduction, they must also take into account the expenses which would undoubtedly follow.

Mr. D. IRVING (Bristol) said, in his opinion, there could be no doubt that the extra price charged to the prepayment class of consumers should be sufficient to cover the additional cost incurred in supplying them. He had for many years taken the greatest interest in looking over the analyses of the Leicester undertaking, because he had regarded Mr. Colson's admirable work as a kind of standard and example which he had in many cases endeavoured to follow. He had noticed that for some time past the cost of distribution at Leicester had steadily increased. In fact, for the last ten years (ever since the prepayment system had been introduced) the cost of distribution had risen, and was now more than double—amounting actually to upwards of 2d. per 1000 cubic feet on the whole of the gas sold. Now, this came to, if his figures were correct, something like 9d. per 1000 cubic feet on the gas sold under the slot-meter system; and it closely approached his own experience, and was very near the figure Mr. Ellery had suggested. He gave the published figures with all reserve, and subject to any explanation which might be known only to Mr. Colson and his staff. But, accepting the figures given in the paper as to the actual costs, which were set out in beautiful order—and the general organization of the scheme reflected the greatest credit on Mr. Colson—the extra price met, within a halfpenny, the extra cost of the system in vogue. Then the net profit per 1000 cubic feet of gas sold at Leicester being about 4d., the result was that if this cost was really covered, there was an increased profit to the undertaking of between £6000 and £7000 a year. Upon this he had only one other remark to make—he offered all these criticisms in the most friendly and respectful way—and it was this: As the net profit from this magnificent extension of business amounted to nearly £7000, he thought it was a little reflection on the municipal administration of the gas undertaking that all this had not resulted in any saving whatever to the poor Leicester consumer; the price of gas being now practically the same as it was ten years ago. He did not know but that the Leicester ratepayer might have benefited. He contended, however, first that the extra price charged on the slot-meter system should be such as to cover the entire cost; and, secondly, that the gas consumers should participate in the benefits and profits derived from the extension of the business.

Mr. W. W. TOPLEY (Croydon) said one point of some interest had been brought out in connection with the method adopted for collection under the slot-meter system. He noted that practically the only check was the comparison made, the morning after the collection, of the amount brought in with the quantity of gas registered, and a margin for error of 2d. per collection per consumer was allowed. Working it out roughly on the figures given, this seemed to show that a margin of 3 per cent. on the total sum collected was regarded as an admissible amount; and it came to a very considerable sum. He mentioned this as showing what appeared to him to be an essentially weak point in the slot-meter system, in that it practically offered an inducement to the collectors—he had nothing whatever to say against them, and no doubt they were honest men—to manipulate to a slight extent their record of the working, whereby they could make a small sum per annum. This might be an insuperable objection to the system. These figures brought out a substantial amount of loss which might be made by the abstraction of a certain number of coppers put into the boxes without the possibility of discovery. With regard to the comparison (in Table III.) of the extra cost per annum for the prepaid consumers, he noticed that 10 per cent. was charged upon the average cost of the cooking-stove for maintenance and renewals. It was said that the average cost was 30s., and 10 per cent. was ample, being in excess of the actual cost of renewal and maintenance; but this did not seem to him to make any provision for interest on the capital expenditure involved. This interest was taken in the case of meters at 15 per cent.; and if it were applied to the stoves, it would make a difference of something like 1·1d. per 1000 cubic feet per annum on the value of the system. There was one other point on which he should like to ask for information, as he was unable to quite gather from the figures the actual state of affairs. It was mentioned that the additional cost for each inspection worked out at something like ½d. per 1000 cubic feet; but, from an indication given elsewhere, it would appear that the cost of inspection and collection on the slot-meter system in Leicester was certainly 1½d. per 1000 cubic feet—leaving 1d. for the cost of inspection and collection for ordinary consumers. This was a little in excess of what was experienced in some parts of the country; and he should like to ask if any items could be given, under these headings, which would explain the apparent discrepancy. It would be interesting to many who had hitherto regarded the supply of fittings, brackets, and stoves with prepayment meters as an integral part of the system, to know what general grounds of reasoning had induced the authorities in Leicester to supply only cooking-stoves. That their system had not acted detrimentally on the sale of gas was shown by a very large average consumption per consumer.

Mr. J. P. LEATHER (Burnley) said there was one side of the question which did not seem to be appreciated by some of the members. No doubt Mr. Colson would inform them how the circumstances of Leicester bore on the remarks which had been so far made; but taking their own case at Burnley, he might say that they did not supply fittings, because all the houses there had services laid on. Out of 20,000 houses, there would not be more than probably 150 which had not services in them when the supply of prepayment meters, or something of the kind, was started. Therefore, they did not provide free services or fittings. The only thing they did was not to charge meter rent, which they did in ordinary cases; and they supplied a small breakfast cooker or griller. They charged about the same difference as Mr. Colson—viz., 5⅛d. The extra cost of collection was 10 per cent., and the additional cost of the meter—and this he worked out generally as well as he could—would come to about the same figure as Mr. Colson had

given, or less than 6d. per 1000 cubic feet. In regard to the method of collection and the shortage of money, every consumer, on asking for a prepayment meter, had to sign an agreement to pay according to the consumption shown by the ordinary index; and if there was any short money, he was expected to pay it, and did so. They had no difficulty about this; and, excepting in the case of runaway customers, they had no bad debts. Their system was evidently different from that at Leicester. Their collectors carried with them a "state-book." They knew exactly how much money there ought to be in the meter according to the register of the index, and they made out a receipt for the money which they took from the box, put down the quantity of gas, and, of course, entered the state of the meter in their books. The different collectors had their districts changed from time to time; so that if one put down a wrong state in his book—which he would have to do to make it agree with his money—it would come out wrong the next quarter, when another collector went round.

Mr. W. B. RANDALL (Waltham Abbey) said there were one or two points which had not been dealt with by previous speakers. In the opening of the paper, a statement was quoted: "The slot-meter system is always unsatisfactory, and involves a considerable amount of loss." He thought this might be justified by the paper, because he noticed that the difference between the ordinary price was only 5⅓d. for the amount of gain put down in the paper. It had been remarked that 10 per cent. on the cost of cooking-stoves was certainly not sufficient; and, from his own experience, he could justify this. He thought if it was put at from 20 to 25 per cent. for depreciation and interest on the stoves, it would be a better working figure. He made these observations because he thought it should hardly go forth that 5⅓d. was sufficient difference between the prepayment and the ordinary consumers. He supposed that every tub must stand on its own bottom; and it might appear that, taking the case of Leicester, a difference of only 5⅓d. would compensate for all the disadvantages which must inevitably accrue from the prepayment system. But when they added the amount of £270 per annum lost through differences, including thefts, he thought it was a very serious point. It was said that there was a general gain to the department through the profit on the consumption by the 10,000 consumers who would not otherwise have used gas. He must congratulate Mr. Colson on the increase of consumption. But how he justified the interest gained or saved through the bank balance and the saving in clerical work, printing and stationery, and the cost of office accommodation, he was thoroughly at a loss to understand, because, from an experience of some ten years, he could only say that the extra clerical work and office accommodation required in collecting accounts, and the printing and stationery, were at least three to one compared with ordinary consumers.

Mr. T. CANNING (Newport) said, if he followed the last speaker correctly, he thought Mr. Colson was charging for his gas a little too low in only making a difference of 5⅓d. It was generally held that the difference should rise as high as 10d. In their case at Newport, it was 8d.; but rather than increase the price to prepayment consumers he should go the other way, and bring it down 2d. to the ordinary consumer. He had been encouraged by the paper, particularly by the small difference in price, which had been found satisfactory. Of the meters at present in use at Newport, seven-twelfths were prepayment meters; and they had rather a higher percentage consumption of gas, because there it was 25 per cent. He was inclined to agree in almost every case with Mr. Colson with respect to the money which he set aside for interest and for repairs and maintenance. He thought the previous speaker, who mentioned 25 per cent. on cookers, was rather beyond the mark. Another gentleman described a system which, at the beginning, he (Mr. Canning) made an effort to try himself, but found it would not work. They began in 1892, and did not do very much the first few years; but in practically the same year as Mr. Colson—namely, in 1898—they started on a large scale. He found, however, that it was of no use taking up the prepayment system unless they adopted it in its entirety. They must provide the cooker along with it. This was the only way in which it could be made to work profitably. To him, who had been working on this system as long as Mr. Colson, it was exceedingly encouraging to hear of his success; and he was very much pleased with the admirable system on which he worked, and the frankness with which he had put down his figures. It was satisfactory to find that he had been so successful, even after allowing for the loss he had incurred, which was compensated for in a great many other ways. With regard to unoccupied houses, there was no doubt whatever that they ought to be watched with extreme care. At Newport they put a notice in large red letters on all prepayment meters, asking the consumers to give notice when they were leaving; and, in nine cases out of ten, the British public were sufficiently obliging to do so. In other cases, however, they did not; and the Company occasionally had trouble in this direction. Another point which sometimes caused difficulty was that of a low average consumption. The question was what was the point at which one should stop and take the meter away altogether. For instance, any amount of care in the selection of the original consumer would not guarantee satisfaction, because the working classes changed their residences very frequently; and though No. 1 might have a wife who liked cooking and was fond of the house, No. 2 might come in and drop it altogether. What was to be done in such cases, which, as the system went on, amounted to a considerable number? It had been suggested to him that they should put down a minimum—the same as the Electricity Department did—and say to a consumer: "You must pay a certain amount (say, a minimum of 12s. per quarter) if you wish to have the privilege of a prepayment meter." He would like to suggest that he should prefer to give notice at once, and take the meter away. Still, there was a difficulty, because when one had a large number of these meters in use, and found, in going round collecting, that in some cases only a few shillings were taken, and in others only a few pence, it was necessary to strike out some line. Whether or not a minimum charge would be the best to take, he was unable to say; and he should be glad to know if any member present, who had been faced with the same difficulty, had devised any method to overcome it.

Mr. HERBERT LEES (Hexham) pointed out that the extra charge at Leicester only covered the provision of stoves and meters. In most of the cases where a difference of 10d. per 1000 cubic feet was charged, the additional cost of fittings was included. He introduced the prepayment system ten years ago; and he found his justification for doing so in this paper. With reference to a remark made as to the amount set aside for depreciation of cookers, he thought that it all depended upon the class adopted. If a very poor cooker was used, a larger amount must be allowed; but if one packed all round was supplied, it would be strong, and they could properly afford to charge less for depreciation. He believed it was usual, in many cases, to supply a cooker unpacked. With regard to the low consumption of gas, the method he adopted was this: He looked through the prepayment-meter book, and found out where the low consumers were; and he then, by a polite note, suggested to them that unless the consumption increased he would be compelled to remove the meter, and offer them an ordinary one in lieu of it. In this way, they had generally been able to improve the consumption. They thought they had suffered recently from the fact that they had very little summer weather—in fact, the greater proportion of the consumption of gas was for cooking purposes. He agreed that those who sought to introduce the prepayment system without cookers, would not, as a rule, be successful.

A MEMBER pointed out, as to free fittings, that in many places throughout the country managers had to meet the competition of free wiring for the electric light. He should have liked to ask Mr. Colson about his attacking the villa residents with some slight effect; but in his case he was afraid it did not apply. Another question was as to whether he introduced gas-fires on the prepayment system, and found any difficulty from the meters being blocked with pennies. Personally, he considered all honour was due to those who went in for the system.

Mr. J. H. BREARLEY (Longwood) asked Mr. Colson as to whether the cookers he used were packed or unpacked. He was surprised to find that he had 25,000 stoves fixed with 26,000 prepayment meters. If they were unpacked stoves, of course he did not wonder that the consumption of gas had increased in so great a ratio as was shown in Table I. He learnt, from the experience of a friend of his who adopted unpacked cookers, that the consumers found them too expensive. One point seemed to have been omitted from the table showing the extra cost per annum of the prepayment consumers—namely, as to the changing of cookers. Did

Mr. Colson experience much difficulty with consumers who had slot meters after a change of tenancy—the next one wanting an ordinary meter, and the slot meter consequently being brought away? He had found this rather a serious expense; and certainly it was not compensated for, in his case, by the 0·2d. per 1000 cubic feet which was stated as the extra cost for the more frequent changing and fetching of meters.

Mr. R. WATSON (Doncaster) said he would not attempt to give any details, but, on the whole, his own experience accorded with Mr. Colson's, that the extra amount charged for the prepayment meter was sufficient. There were many facts which helped to show that the slot consumer was rather more profitable than appeared on the surface. For instance, it might be suggested that these consumers took the gas at a time when the works could best spare it. The summer consumption was almost as high as the winter. They consumed a great deal of gas in the daytime, and in the evening they took over the whole lighting hours from dusk until the people went to bed; whereas the ordinary consumer, on whom they depended most—the shopkeeper—took gas for only a short period, from dusk until he closed his shop. Therefore the slot consumer was much like the public lamp consumer—he took the gas over the distributed time, and during the daytime, and lessened the standing charges per 1000 cubic feet of gas sold. Mr. Ellery had mentioned the fact that the slot-meter would probably increase the cost of distribution in future. But he (Mr. Watson) thought in the majority of cases the prepayment consumers had been served from the existing mains, and, as a consequence, there had been a saving in the capital charge per 1000 cubic feet, which in his own case was about 10·4d. Taking it thus, there were about 8 to 10 yards of main per consumer, of which they had been saved the cost in capital charges. They had also saved, as against the slight loss in bad debts (including thefts), in this way—that if they had depended on the ordinary consumer with an ordinary meter, which required a deposit of 10s., with an average consumption of 10,000 cubic feet per annum, it meant interest at the rate of 0·6d. per 1000 cubic feet. The money saving came out at about 2d. These figures had not been taken into consideration, but could be regarded as a very fair set-off against what might sometimes be called the inadequate figures for the cooking-stoves.

Mr. COLSON, in reply, expressed pleasure that his contribution to the proceedings of the Institution had resulted in so interesting a discussion. Mr. George Helps was of opinion that it was owing in some cases to the number of fittings provided that so much trouble was experienced in connection with the prepayment system. He (Mr. Colson) was in complete agreement with Mr. Helps; and, holding this view, the accessories in Leicester were confined to a cooking-stove and a moderate length of piping. In reply to Mr. Ellery, who preferred supplying all kinds of fittings, he might say that the size of meters fixed in Leicester for some time past had been 5-light, although a number of 3-light meters fixed formerly were still in use. He could not lay too much stress upon the necessity of all meters and stoves, before being adopted, being thoroughly examined and tested. He was of opinion, after considerable attention to the matter, that the 10 per cent. charge for interest and upkeep was sufficient. As to the proper time of taking pressures, in his case, too, he found that this should be done at mid-day on Sunday during the summer months; for at least during five months of this season of the year their maximum delivery occurred from 11.30 to 1.15 on that day. In reply to Mr. Irving's question as to the increased cost of distribution in Leicester during the past ten years, as shown in "Field's Analysis," he was fully aware of this enhanced cost, but it arose, not from the use of prepayment meters, but from the fact that, with increasing prosperity, they had charged to revenue more freely than formerly items of expenditure which might legitimately have been charged to capital, with the view of keeping this account as low as possible. As to the check upon the men being sufficient, in his opinion their system had proved sound in this respect. No doubt there was greater risk in connection with the prepayment than with the ordinary system; but the risk could be minimized by employing thoroughly trustworthy men, and the staff checked by an independent inspector, as he had stated in the paper. The gentlemen from Burnley and Newport were confident that the extra charge of 5⅓d. in Leicester was insufficient; but he (Mr. Colson) contended that in their case it had proved, not too much, but ample. In reply to Mr. Lees, gas-fires were not supplied in Leicester, and they were using both packed and unpacked cooking-stoves, but mainly the former.

The PRESIDENT said they were all thankful to Mr. Colson for his paper, which had led to a most useful discussion. The question of the day supply had an aspect which was very important indeed; and to him it was news to find that the consumers in Leicester actually burnt more gas in the two summer quarters—viz., 22 per cent. and 28 per cent.—than they did in either of the other two. This told very largely on the storage capital and the mains capital. It was true that occasionally one might have to extend a main, and there might be peaks of pressure on Sunday; but, on the whole, it regulated the load-factor, and made it much more profitable. The profit was not merely in the receipt of the 5d., but in other ways. Mr. Irving had spoken of the extra cost; but against this must be set the 5d. on the other side. They were much indebted to Mr. Colson for bringing forward a valuable subject in connection with their daily work.

EXPERIENCES AT MIDDLESBROUGH WITH GASHOLDER TANKS ON MARSH LANDS.

By DAVID TERRACE, of Middlesbrough.

As for many years the gas undertaking of the Middlesbrough Corporation has been most unfortunate in its experience with gasholder tanks constructed on what is termed the Marshes site, it occurred to the writer, on being asked to contribute a paper, that a few notes on the difficulties, and the means adopted to remedy them, might be interesting to the members of the Institution. The trouble started nearly thirty years ago, when the gas-works site, being too small, it was decided to construct a concrete tank on this site, which is about 900 yards distant from the works. As the name implies, the ground is of a marshy nature, and is, in fact, the bed of an old river which was subject to tidal action. Sections of the substrata are shown on Diagram No. 1; that represented at A being what was found by an exploration pit (6 feet square by 34 feet deep) before No. 4 tank was begun. It is surprising that the terms used (or the ground itself) show such varying results. For instance, near the bottom of the excavation, "loam, strong and solid," was then said to be found, whereas now we designate what appears the same strata as "soft clay," which it has in reality proved to be.

The drawings and specification for the gasholder tank, 182 feet diameter by 35 feet, were prepared by the Gas Engineer at that time; and a section of the proposed tank is given on Diagram No. 1. Tenders were obtained, the contract let, and the work proceeded with. The contractor had not any previous experience with tank construction, and, as the nature of the site was such as would require all the skill of those accustomed to this class of work, it was hardly to be expected that it would be accomplished without at least a few mishaps. After about two years' operations, the tank wall, part of which only had by that time been constructed to half the height, suddenly gave way. Two eminent Consulting Engineers from different cities were called in to report on the construction and collapse, and to give advice as to the advisability or otherwise of abandoning the site. Both agreed that the design of the tank was good, and that the collapse was entirely due to faulty execution of the work. The immediate cause of failure was the pressure from the loose earth behind the wall adjoining the street, assisted greatly by the water from dislocated drains. It appears that from some unexplained cause there had been no supervision over the contractor, who, besides making many serious blunders, had on many points altogether ignored the drawings and specification. The concrete bed, 12 feet wide by 3 feet thick, which was to form the base of the tank wall, had been altogether omitted, and the wall only made 3 feet thick, instead of 4 ft. 3 in., without any attempt to widen the base, although the stratum was of soft clay. At the time of the accident, the clay at the base of the wall was excavated for about half the circumference (instead of only two yards at a time) for the permanent concrete flooring; and the pressure from the outside forced a passage below the wall and allowed the earth and water from behind to be carried into the tank, and the wall fractured in several places.

GROUP OF ABOUT 40 RAILWAY SIDINGS.

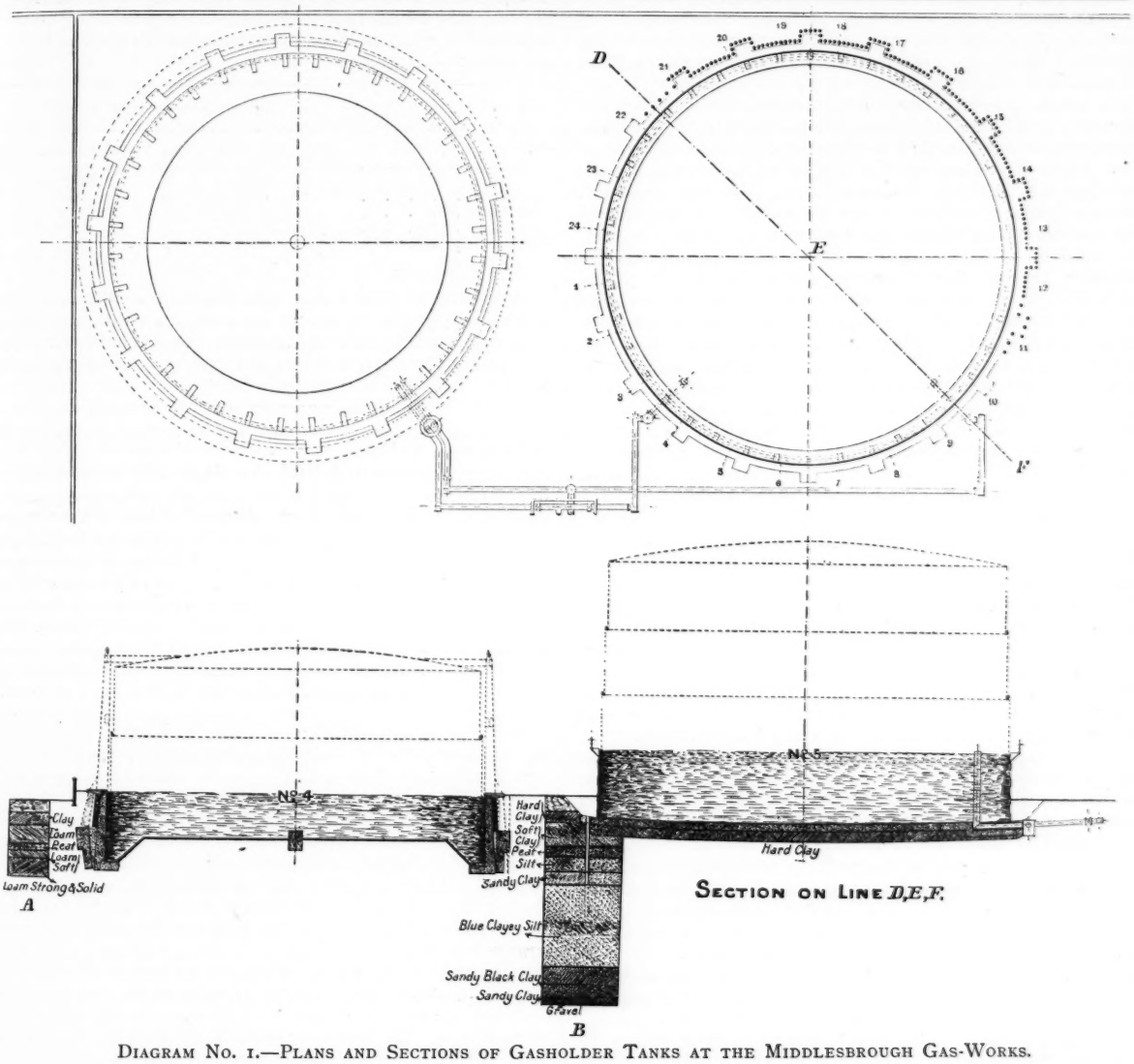


DIAGRAM No. 1.—PLANS AND SECTIONS OF GASHOLDER TANKS AT THE MIDDLESBROUGH GAS-WORKS.

These Engineers recommended that a new tank of smaller diameter should be constructed within the one that had collapsed; and this work was carried out to the design of an eminent London Engineer by a reliable contractor without mishap. On completion, it stood filled with water for two years; and when emptied for the erection of the gasholder, the greater part of the side was found to be cracked, apparently through the subsidence of the foundation, and the cone also showed several cracks. These, however, were repaired during the construction of the holder; and the tank has proved tight during the past twenty years. The holder was telescoped in 1893; but

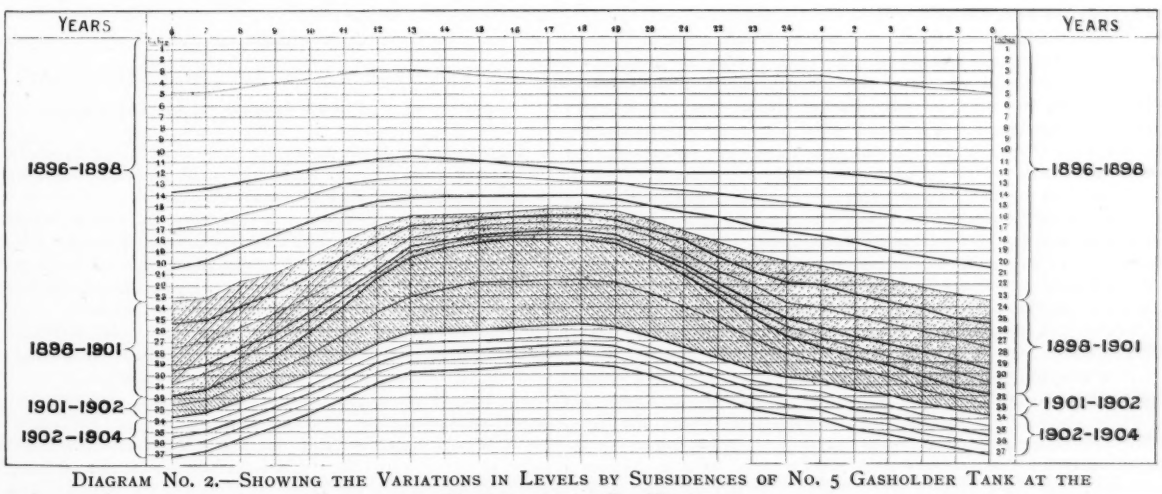


DIAGRAM No. 2.—SHOWING THE VARIATIONS IN LEVELS BY SUBSIDENCES OF No. 5 GASHOLDER TANK AT THE MIDDLESBROUGH GAS-WORKS.

[The Proportional Scales are: Vertical, full size = Horizontal, $\frac{1}{192}$]

being provided with a cup, it was not considered advisable, as it was not necessary, to empty the tank of water. The cost of the various works may prove interesting. The amount spent on the first tank, including constructing the new one of reduced size, was £20,000; thus running the expenditure to £30 per 1000 cubic feet tank capacity, instead of £14, as it would have done by the original design.

In 1895, it became necessary to again increase the gas storage; and as the work had been delayed as long as possible, and it was decided to place No. 5 tank adjacent to that which had given so much trouble, the writer recommended the erection of a steel tank, 185 feet diameter, on the ground surface, so as to avoid the troubles of excavation, and to have the holder in use within a year, if possible. The foundation consisted of a large bed of concrete, 3 feet thick; and as settlement would almost certainly occur, the inlet and outlet pipes were made with articulated joints of simple construction to allow for this. Each joint consisted of a socket, cast dove-tail fashion, into which was inserted a turned dove-tailed spigot, the space between them being run in with lead and caulked in the usual way. These joints have not caused any trouble. It was decided to guide the holder on the wire-rope system; and subsequent events proved the advisability of so doing. The total weight of foundations, tank, holder, and water is about 32,000 tons. This apparently great weight, however, only works out at about 24 cwt. per square foot of area; and although settlement was anticipated, it was not thought that it would prove at all serious. As a safeguard, however, before filling the tank with water in 1896, marks were made on the side of the steel tank at 24 equi-distant points round the circumference, so that the depression at each of these could easily be obtained by means of a dumpy level. The subsidence at the various points is shown on the Diagram No. 2. The vertical scale being regarded as full size, the horizontal scale would be $\frac{1}{192}$; so that the levels show more clearly by exaggeration.

In 1897, when the difference in level was 8 inches (23 inches − 15 inches) the tank was emptied, and the rest stones re-levelled. Attention was then called to the comparative rapidity with which one side of the tank was sinking; and the writer suggested the principle of lowering if possible the high side of the tank by trenching round it—thus cutting through the hardened strata near the surface. On calling expert advice, the question was discussed as to the principle of re-levelling by restraining the substrata from spreading further; but no action was taken. In 1901, the difference in levels had reached $13\frac{3}{4}$ inches ($31\frac{3}{4}$ inches − 18 inches); and the holder then being in danger when cupping and uncupping, the writer's trenching scheme was again propounded. The Gas Committee, after fully considering the question of abandoning the whole structure and erecting a new holder, entrusted the task of preserving the tank and holder to him.

The strata on Diagram No. 1 at B shows a thin bed (5 feet) of fairly hard clay, with a thick substratum of soft clay intersected by peat and silt bands till rock is reached about 80 feet from surface. A group of about forty railway sidings adjoins the tank site—the nearest being 20 feet and farthest 550 feet from the tank; and it was concluded that the constant heavy traffic in use on them for the past 40 or 50 years had had the effect, on such a soft stratum, of compressing the ground and forcing a great portion of it underneath a considerable part of the foundation of the tank—thus causing the unequal subsidence, and consequent great difference in levels. To make an ordinary trench-cutting through the harder top strata to reach the very soft clay at a depth of about 30 feet seemed a very difficult piece of work; so instead of excavating, strutting, &c., in the usual manner, a "perforated trench" composed of boreholes was made. The plan shows the position of these boreholes, about 150 in number. They were 16 inches in diameter, and varied in depth from 30 to 50 feet according to the nature of the strata; and the boring was continued until very soft watery material was reached, such as could not be raised by the boring tool.

The weight of the tank bearing hard on the edge near these borings squeezed the soft clay into them, and thus a lower level was reached by the tank on that side. At the commencement, the spacing of the holes was about 20 feet apart around the semi-circumference next to the railway sidings; but these spaces were afterwards divided and subdivided as the subsidences showed to be necessary by the weekly, and sometimes daily, taking of levels. It was found that in places the strata were very sensitive to the action of these boreholes; and borings were only made where the ground was found to be hardest, as indicated by dumpy level. The effect of these operations is shown in the following table:—

Years.	Average Subsidences per Month.	
	High Side.	Low Side.
	Inches.	Inches.
1896-98	0·52	0·80
1898-1901	0·08	0·24
1901-02	0·63	0·16
1902-04	0·14	0·14

It will be observed that after twelve months work the sinking action was reversed; the tendency of the tank being to sink less on the soft side and more on the hard side. By this means, although there is still a tendency to sink gradually, the tank is slowly reaching a comparatively stable position; and in all probability, had this method of trenching been adopted in 1898, the tank would not have sunk so rapidly on the soft side, and thus regained its level sooner. Last year the tank was emptied, and the three lifts of the holder re-roped; and these have since worked satisfactorily. The total cost to date has been about £30,000 for a holder capacity of $2\frac{1}{4}$ million cubic feet, which works out to £13 per 1000 cubic feet. If a new holder on a distant site had been erected, it would have cost over £50,000; so that the interest and redemption on this sum, which would have amounted to £3000 per annum, has been saved. Credit should also be taken on the saving on property of between £20,000 and £30,000 (the value of the present holder), which would have been condemned as useless had a new holder been erected.

The PRESIDENT said the members had heard an interesting account of what must have been a very great trial to Mr. Terrace all these years. In the first tank, somebody blundered very much—the Contractors were not properly looked after; and in the second too much faith was put in 3 feet of concrete. It was often thought that these tanks were a very simple matter; but it was not so. A Yankee once said that water was the heaviest thing in creation to hold, and so it was; the reason being that, though soil would give a pressure of 25 cwt. to the square foot, if a second square foot were put alongside the first, another by the side of that, and so on, a very different problem would be presented, because there was no resistance for the pressure to discharge itself through, and it was carried down in a straight line. He had mentioned in his address the marshy soils they had to contend with where they put works near rivers; and this was exactly the difficulty Mr. Terrace and his predecessors had. He must congratulate him on the skill and ability he had shown in making the perforations in the soil immediately adjacent, and encouraging the tank to sink in a somewhat less capricious manner than it was doing before. The meeting would sympathize with him in his trouble, and congratulate him on his success. His paper was a very useful one; but it was hardly necessary, nor was there time, to discuss it.

CONDENSATION OF ILLUMINATING GAS.

By H. G. COLMAN, Ph.D., M.Sc., of London.

Two to three years ago, papers were read by Mr. Charles Carpenter and Mr. A. F. Browne, at the meetings of the Southern District Association and the Institution of Gas Engineers respectively, in which an exhaustive investigation was made more particularly of the quantity of heat which has to be removed from the gas to cool it from 140° to 60°, and the different methods by which this can be accomplished. In this paper the author proposes to consider chiefly what may be called the action of the condensing apparatus as a washer or scrubber for the various vapours present in the hot gas issuing from the retorts.

In the early days of gas manufacture, the only object aimed at was simply to cool the gas and separate from it the tar and liquor produced in the process; but in the course of time, it was found that the manner in which the cooling was brought about had an important bearing on the illuminating power of the gas, inasmuch as the amount of the vapours

of the lowest boiling constituents of the tar retained in the gas varied with the manner of cooling adopted. Later on, it was discovered that, in addition to this, the method of condensation stood also in some relation to the subsequent tendency of the purified gas to deposit naphthalene in the mains and services. The objects now aimed at in condensation may therefore be taken as the reduction of the hot gas to atmospheric temperature, at the same time retaining in the latter as much of the most volatile tar constituents (mainly the benzene, toluene, and, to a much smaller extent, the three xylenes) as it can permanently carry at the lowest temperature to which it may be afterwards exposed, and also to effect the complete elimination of naphthalene and all other higher boiling substances.

Under present-day conditions, when so large a proportion of the gas is used for heating or power purposes, the retention of the above vapours has no longer anything like its former importance, as the effect of these on the calorific power of the gas is much less than on the illuminating power. But even now, simply from the calorific point of view, these vapours are more valuable in the gas than when left in the tar, provided that they can be so retained at little or no expense, and that they are not deposited before the gas reaches the consumer. Thus, for example, a gallon of benzene, as vapour, has a calorific power of 156,464 B.T.U., which is equivalent in heating value to about 260 cubic feet of gas of 600 B.T.U. If the cost of gas into the holder is 1s. per 1000 cubic feet, the value of this amount of benzene in the gas would be about 3d.; whereas in the tar only 1d. to 2d. is usually obtained for it.

From the present point of view, the whole of the apparatus in which cooling of the gas takes place must be considered—viz., the ascension and dip pipes, hydraulic and foul mains, and the condensers proper. The high-boiling constituents are liquefied by the time the gas leaves the hydraulic main; the remainder separating in the foul main and condensers. The high-boiling substances which first liquefy have, however, the power of absorbing from the gas a part of the more volatile constitutents, at temperatures much above that at which the latter would liquefy in their absence; and it has long been recognized thatthe amount of low-boiling hydrocarbons and naphthalene left in the gas depends upon the manner in which the tars first separated come in contact with the gas still containing the benzene, &c., in the state of vapour. But in spite of the recognition of this fact, there is still no general agreement as to the principles according to which the condensing system should be arranged in order that the tars separating as the cooling proceeds shall be compelled to act on the gas to the best advantage.

In actual practice, the greatest variation is found in this respect at different works, and often in the same works. Thus in some places the hydraulic main tar is removed at once from further contact with the gas; while in others it is allowed to flow with the gas along the foul main to the condenser inlet. In most cases, the foul main is so arranged that the condenser products flow with the gas stream; whereas in a few instances (see Humphreys' "Chemistry of Illuminating Gas," p. 222, and Mr. W. R. Herring, in the "JOURNAL OF GAS LIGHTING," Vol. 81, p. 537) these products flow back to the hydraulic main against the current of the gas. In the condensers themselves, again, there is the widest divergence in the flow of the condensed liquids, whether in atmospheric or water-cooled, vertical, or horizontal condensers. Sometimes the whole of the liquids separated in the condenser flow with the gas from inlet to outlet, and sometimes these all flow against the gas stream from outlet to inlet. More commonly the condensers are split up into sections—the tar and liquor, separating at different temperatures, being drawn off separately; and in some the tar in each section always flows with the gas stream, in others always against it, while in many condensers, such as the "battery," the tar stream is alternately with and against the gas. There is but little experimental evidence available as to the benefit or otherwise of any of these methods; and what there is is far from conclusive. The gas engineer, therefore, when extending or renewing his condensing plant, has no valid data to guide him in designing an apparatus which shall be most effective from the point of view now under consideration.

The cause of the lack of information in this respect lies without doubt in the fact that any investigation of the point must be made on a manufacturing scale, as it is hardly possible on the laboratory scale to reproduce even approximately the conditions which exist on the large scale. On the other hand, with the ordinary manufacturing plant in daily working, it is impossible to maintain the other conditions constant, and vary only the flow of the condensation products in the condensing system; so that when any modification is made in the latter respect, some unintentional alteration also happens to take place—such as different coals in use, variation of heats, &c.—and renders the results obtained unreliable. This is, in fact, one of the problems which can only be satisfactorily investigated in an experimental works, the equipment of which has so frequently been advocated, especially by Mr. J. W. Helps, and by Mr. Dougall in his presidential address last year.

Nevertheless, although gas-works practice does not afford much help at present in solving the problem, assistance may be obtained from the experience of other industries, and in particular from those in which fractional distillation is carried out. In these, the object to be attained is very similar to that desired in gas-works, as may be seen by taking a specific example—namely, the preparation of pure benzene from the light oils obtained in the first distillation of coal tar. Here the light oils are heated in a still, and a vapour is given off, which, in addition to benzene, contains large quantities of higher boiling substances, and if condensed at once would yield a sample of benzene far from pure. The vapour first evolved is therefore subjected to fractional condensation, to remove all the higher boiling constituents; and although in outward form and detail the various devices employed differ considerably, there is throughout them all one underlying principle—viz., that the products which separate in this fractional condenser all flow backwards against the stream of ascending vapour.

The result of this arrangement is that the mixed vapour is first brought in contact with the liquid formed from the vapours of highest boiling point, and, as it ascends, comes successively in contact with liquids boiling at lower temperatures, and is finally washed by a liquid consisting chiefly of benzene with but little higher boiling substances; so that at the outlet of the condenser practically pure benzene vapour remains, which is then completely condensed. The counter-current principle here employed is utilized in many other processes, and, indeed, is almost universally adopted in the processes of gas purification subsequent to condensation. Thus, in the extraction of ammonia, the gas richest in ammonia comes in contact with the strongest liquor, and then successively with weaker and weaker liquor until the last traces of ammonia are removed by the action of fresh water.

It will be seen, therefore, that in such a process there is a marked similarity with the requirements in the condensation of illuminating gas (whether coal gas or carburetted water gas), as in both cases we have to deal with the fractional condensation of mixed vapours of different volatility; and, by analogy, it seems most probable that the systematic adoption of the counter-current principle would also be the most suitable in the latter case. With illuminating gas, however, there are certain important conditions which are not present in the case above considered. In the first place, we have then a large quantity of gas mixed with the vapours which is not liquefiable at the temperatures reached in the process of condensation. In principle, this does not materially affect the case, as the gases are really the vapours of liquids which condense in the same manner at sufficiently low temperatures; but the dilution of the vapours which are to be removed with large volumes of gas renders it more difficult to effect the washing out of the vapours to be removed by the action of the separated liquids.

In the second place, during the condensation of the hot gas, one of the vapours which liquefies is the steam; and the water formed does not mix with the liquid produced by the other vapours. This does not affect the liquefaction of the latter with falling temperature, inasmuch as with non-miscible liquids each vapour separates just as if the other were absent, and the water exerts practically no solvent action on the other vapours, although it combines with the ammonia, sulphuretted hydrogen, and carbonic acid present, forming ammoniacal liquor. But the ammoniacal liquor thus formed, which is greater in bulk than the separated tars, and specifically lighter than these, tends to form a layer above them, and has a very deleterious effect in preventing these tars from exerting their solvent action on the vapours which it is desired to remove. This would be, of course, the case

Fig. 1.

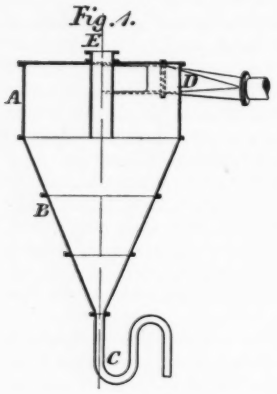


Fig. 2.

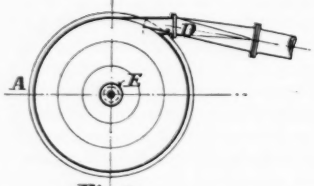


Fig. 3.

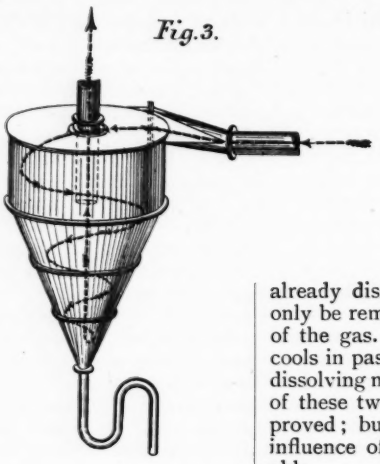
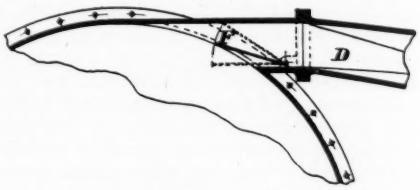


Fig. 4.



whatever the direction in which the condensed products are flowing.

In the third place, a very material difference in the case of illuminating gas is that in the earliest stages of cooling after the gas leaves the retort, and before the condensation of the aqueous vapour commences, the fall of temperature is exceedingly rapid, owing to the proportionately small number of heat units which have to be removed for a given lowering of temperature, and the great difference between the temperature of the gas and that of the surrounding atmosphere. As a result of this rapid cooling, the heavier tars separate out as a dense fog of finely-divided particles or vesicles. By the time the gas leaves the hydraulic main, its temperature is reduced to 140 to 150° Fahr.; and at this temperature some 90 to 95 per cent. of the condensable vapours other than steam have already liquefied. Although the larger portion of this is retained in the hydraulic main, a very considerable quantity is carried on mechanically with the gas, and is only gradually removed by settlement or friction with the sides of the mains, being still present in the gas in appreciable quantity after it has been cooled to atmospheric temperature. Owing to its fine state of division, this tar fog presents an immense surface to the gas, and is evenly distributed through it, so that its solvent action is much more rapid than that of the tar condensed on the surface of the pipes, which is also partly protected from the gas by a layer of ammoniacal liquor. This fog also, so long as it exists as such, must inevitably travel in the same direction as the gas—being simply carried on mechanically with the latter; and so long as this is present, it is impossible to carry out the counter-current system thoroughly.

This tar consists, of course, in the first instance, of the highest boiling tar constituents, which, at the temperature of formation, only dissolve small quantities of the lowest boiling vapour (benzene); but if, as is usually the case, they travel forward with the gas, their temperature is reduced, and they then absorb a further quantity of benzene, which, but for their presence, would have been permanently retained in the gas--a reduction in the illuminating power being thus brought about. The presence of the heavy tar fog in the condensers affects the removal of the naphthalene in two ways—one favourably and the other adversely. On the one hand, it removes from the gas the vapours of the light oils, and thus tends to prevent their reaching the cold end of the condenser, where their action on naphthalene would be greatest. At the same time, such fog as gets forward to the cold end mixes with the light oils which do separate there—thus increasing their naphthalene content; so that these, being more nearly saturated with that hydrocarbon, are unable to wash out the latter from the gas as completely as they would otherwise have done, for the entire removal of naphthalene can only be effected by the final action of solvents containing but small quantities of it already dissolved, just as the last traces of ammonia can only be removed by water containing but small quantities of the gas. On the other hand, the heavy tar fog, as it cools in passing through the condenser, is itself capable of dissolving more naphthalene than is the case at 140°. Which of these two factors has the greatest influence, is not yet proved; but the writer thinks it is most probable that the influence of the heavy tar fog is more adverse than favourable.

A sufficiently slow cooling of the gas in the early stages to prevent the formation of fog is probably impracticable; and if, therefore, the counter-current principle is to be adopted in the later stages, the fog thus produced must be removed from the gas as soon as possible. To some extent this is frequently done by allowing the gas to pass through long foul mains of ample size between the hydraulic main and the condensers; and in the comparatively slow travel the tar fog partly settles out, and is partly removed by friction. Its elimination is, however, very incomplete even then; and the provision of such mains to a greater extent than is necessary for actually connecting the hydraulic main and condenser involves a considerable capital outlay. A simple and compact apparatus which would carry out the removal of the fog effectively would be much more advantageous; and very many different forms of plant have been tried for this purpose, some of which are in use at the present time.* In all of these, the principle adopted is to divide the gas up into small streams and remove the tar fog by surface friction or impingement. Some of them appear to have been given up on account of the readiness with which they become blocked, and those which are still in use only appear to effect a partial removal of the fog.

It seemed to the author probable that, as the solid and liquid particles are so much heavier than the gas, they might be removed simply by means of centrifugal force, especially as it is possible to separate fine dust from air efficiently in this manner. After experiments with a small apparatus on a plant making 50,000 cubic feet of gas per diem had shown that such was the case (see "JOURNAL OF GAS LIGHTING," Vol. LXXIX., p. 1486), a larger one, capable of dealing with a million cubic feet per day, was fixed on the coal-gas condenser inlet at the Tottenham Gas-Works. The apparatus, as will be seen from the drawing (figs. 1 and 2), consists of a wrought or cast-iron cylinder A, underneath which is an inverted conical portion B, to the lower end of which is attached a syphon C for the removal of the liquids which separate in the apparatus. The inlet is formed by a rectangular trunk D entering the cylinder nearly at a tangent, but with a slight inclination towards the top and side. The outlet main E is fixed in the centre of the cylindrical portion as shown. The velocity of the gas entering the apparatus is regulated by means of the flap-valve F, which can, if required, be arranged to adjust itself automatically. The gas entering thus at a tangent, sets up a whirling motion of the whole contents of the separator; the spiral course taken by the gas being represented diagrammatically in fig. 3. Under the influence of the centrifugal force thus brought about, the solid and liquid particles are driven to the circumference, where they coalesce and fall down the sides and away by the syphon; while the gas, nearly or wholly freed from suspended matter, passes out from the centre. As will be seen, the apparatus is automatic in action, and perfectly simple and open in construction, and therefore unlikely to become blocked. The only power required in using it is represented by the back-pressure which it throws; and this,

* See Aitken, English Patent, No. 2587 (1874); St. John, English Patent, No. 1466 (1876); Somerville, Hot Frictional Condensation (1883); Peaty, "JOURNAL OF GAS LIGHTING," Vol. XXXVII., p. 807; Eastwood, *ibid.*, Vol. XXXIX., p. 1196; Child, *ibid.*, Vol. LXXIX., p. 629; Everitt, *ibid.*, Vol. LXXXI., p. 634; and Hovey, *ibid.*, Vol. LXXXIV., p. 40.

with suitable dimensions of the cylinder and connections, need not exceed 1 inch.

The gas at Tottenham, after leaving the hydraulic main, passes through about 230 feet of 18-inch foul main before reaching the separator; the tar stream flowing with the gas being removed just before this point, at which the temperature of the gas averages about 130°. In passing through the separator, the gas gives up about $3\frac{1}{8}$ gallons of liquid per 10,000 cubic feet of gas, of which 60 per cent. is tar and 40 per cent. liquor. The amount of tar present in the gas as a fog at this point is therefore 2 gallons per 10,000 cubic feet, or one-fifth of the total tar being made. The amount of such tar fog will, of course, vary at different works, owing to modifications in the construction of the plant preceding the condensers. The tar which separates in the condenser proper, when the separator is at work, is a thin liquid resembling oil tar more than ordinary coal tar, and is but small in quantity—amounting, as nearly as could be measured, to about one-third of a gallon per 10,000 cubic feet. It was found to contain some 30 per cent. of naphthalene and about six times as much light oils as are present in the average tar produced at the works. The separator has now been at work for six months; and during this time it has never required any attention whatever. At one time 2 million cubic feet of gas was passing through it instead of the 1 million for which it was intended; and even then the fog separation was equally effective, although, naturally, under these circumstances, the back-pressure thrown was decidedly greater.

The results of the tests made so far to ascertain the effect on the amount of vapours retained in the gas, and the amount of naphthalene left in, appear to show that the apparatus has a beneficial effect in both respects. But here, again, the variations in other conditions of manufacture during the time the tests were being carried out make it difficult to draw definite conclusions on this point. There is, however, no doubt that by its means the tar fog is effectively and simply removed; and this alone is a considerable advantage, inasmuch as the whole of the heavy tar is then removed while it is hot and fairly mobile, and the tars separating later are comparatively thin at the ordinary temperature, and less likely to give trouble in their removal. Although the apparatus was more particularly designed for use with hot gas, it will be seen that it is equally applicable for the separation of tar particles from the cooled gas; and it is at present being used for this purpose at coal-gas condenser outlets, and also for the removal of the fine oil-tar fog so persistently retained by the cooled carburetted water gas, which has such a prejudicial effect on its subsequent purification.

Before concluding, reference must be made to an apparatus devised and tried on the large scale some 25 to 30 years ago, in which the tar fog was removed at a temperature of 130 to 140°, and the counter-current principle adopted in the subsequent condenser; this being arranged with the view to obtaining as efficient a washing surface of the separated tars as possible. This was the "analyzer" of Messrs. Aitken and Young, to the latter of whom both the gas and shale oil industries are so deeply indebted for his valuable work on this and kindred subjects, together, in later years, with his colleagues Messrs. S. & T. Glover. This apparatus, constructed on the principle of the Coffey still, and of the many still-heads now used in fractional distillation, does not seem to have been finally successful. The writer has been unable to find any detailed discussion of the reasons for this; but as far as he has been able to gather, the difficulties experienced were twofold. In the first place, the apparatus became blocked in time with thick tar and naphthalene, and in the second the amount of vapours left in the gas was greater than it could permanently retain during distribution. It seems not unlikely that the first difficulty would be got over if the bulk of the heavy tar fog were previously removed by the centrifugal separator described above, so that only thin tar was present in the "analyzer;" while the second difficulty arose probably chiefly from the fact that in Scotland, where the "analyzer" was mostly tried, the amount of light oils produced from the coals then in use was very much higher than is now the case in the South of England and the Midlands. It is quite possible that, under present conditions in these localities, the presence of excess of vapours in the cooled gas would no longer occur; and it would seem therefore that the "analyzer" is worthy of a further trial with the modification suggested above.

Discussion.

Mr. H. Townsend (Wakefield) said he had had some little experience, at the Wakefield works, of the matter dealt with in the paper. Under the old plan, with horizontal retorts, they were much troubled with naphthalene. Two years ago they put in an installation of inclined retorts, and as soon as they began working with them, they found there was no naphthalene in the works, but it was deposited in the district. To partly obviate this, they put in a tar separator, which diminished the trouble to a considerable extent. Knowing that there had been a good deal of difficulty on account of this apparatus being choked with thick tar in winter, they purposely placed it in a warm position, and kept the temperature always above freezing-point; and they had no annoyance from stoppages. But with the inclined retorts they had trouble with the hydraulic mains becoming unsealed. No matter at what pressure they worked, they had the same difficulty with the exhauster, even with a level-gauge, which was due probably to the great obstruction of the gas for a short period in driving the contents of the hydraulic out into the tar main. They tried a good many different remedies, but did not effect a cure. At last they put in two tar towers, and these enabled them to completely overcome the difficulty. At the same time, he adopted the Sheffield remedy for naphthalene; and all the condensers had a high temperature—keeping the outlet as high as 80° Fahr. From the time of making these alterations to the present, they had not had a single complaint of naphthalene, and had not seen any, either in the works or in the district. Unfortunately, so many things had gone on at the same time, that it was rather difficult to say to which in particular the improvement was due. They did practically what Dr. Colman had recommended. They removed the heavy tar from the hydraulic main by means of towers; then the gas was slowly cooled by passing through large-size foul-mains until it reached the condensers, which were covered in and brought to a high temperature. They were on the battery principle. Each pipe had a brush which imparted a considerable amount of friction to the gas; and consequently at the outlet, all the heavy tar and a good deal of the tar fog had been eliminated. It then travelled to the exhausters and entered the tar-extractor at about 75°, and then the extractor took out all the remaining tar. It was a regular thing to find that the gas would not soil a piece of white paper held in a stream of it. They had therefore followed almost the exact course recommended in the paper, and, so far, with the most beneficial results. Whereas they used to be troubled with naphthalene, now, using the very same coal, they had absolutely no deposits, either in the works or on the district. These facts supported the theory enunciated in the paper; and he must express his acknowledgments to Dr. Colman for so satisfactorily clearing up the matter. Mr. Townsend added, in reply to the President, that the eliminated tar was, if anything, slightly better than before.

Mr. W. E. Price (Hampton Wick) said the paper was entitled "Condensation;" but it was a very difficult thing to keep naphthalene out of the discussion. The question of condensation and the temperature to which the gas should be cooled down was one upon which they would not all agree. Some thought it better that the gas should not be taken to the condensers at a low temperature; while others held the contrary opinion. The last speaker said he obtained relief from the naphthalene difficulty when he kept the temperature up. This was attempted at Sheffield later, and abandoned. His own experience supported the view that when the temperature of the condenser increased, naphthalene appeared; that when the natural temperature rose so that the outlet condenser could not be kept down lower than about 70°, the effect was that naphthalene in large quantities appeared. He had been making lately a great many experiments with regard to naphthalene; but during last winter they had to be abandoned because there was none in the gas. Then the temperature would go down probably as low as 50°, or even 45°; but since the weather had been warmer, so that it rose to 70° or 80°, the naphthalene had appeared. It ranged from none, or not more than 2 grains per 1000 cubic feet, to as high as 18 grains. They had tried various methods, as suggested, with regard to the heavy and light tars; and the experiments were still going on. Instead of getting the light oil out of the tar, crude xylene had, for convenience of experiment, been purchased, and introduced

into the condenser in different positions, and the effects were noticed. They had been very marked. On one or two occasions the naphthalene practically disappeared; but he was sorry to say they were not able to continue this condition, and though the naphthalene had been reduced, it had not been entirely eliminated. At the present time, instead of being, in round figures, about 18 grains, it would be down to about half as much as that. What they were doing now was to carry out the suggestions in another way, and trying the effect of the introduction of tar which had been collected at the cool end of the condenser into the hot end; the object being to settle the question whether it was more likely to extract from the tar the benzene and xylene than the naphthalene. When opinions differed so widely, and one gentleman said he did a certain thing and got a good effect, while another did precisely the reverse and got an equally good effect, it was very difficult to know what was the best course to pursue.

Mr. A. F. Browne (London) said the paper was an exceedingly interesting one, and was so full that it deserved very careful study. He gathered that, on the whole, Dr. Colman was in favour of the reduction of the temperature in condensers to that of the atmosphere, provided certain precautions were taken which would have the effect of retaining in the gas those constituents which some people thought were likely to be removed by too sudden and drastic condensation. Certainly no one was prepared to lose anything from the gas. Even the advocates of reducing the standard of illuminating power had no intention of losing anything; they wanted to spread any surplus luminosity over a larger volume. Similarly, no one wished to sell for a penny or twopence that which was likely in any form to be worth threepence. The paper by Dr. Colman was so large, and the time was so short, that one must not be tempted to discuss too many points in it; and he thought perhaps it would be best for members to state their own personal experience. If he were in order, he should like to institute a comparison between two works of the South Metropolitan Gas Company—Vauxhall and Bankside—in which two very different systems of condensation at present existed. He might preface his remarks in regard to the condition of things at Vauxhall by the statement that the system was condemned, and had been for some years; and it would have been altered before this but for the fact that, the output there being some 13 million cubic feet as a maximum, it was evidently a very expensive piece of work, and it was necessary that a new system of condensation should be tried for some years before any change was made. At Vauxhall they had only the old-fashioned tubular condensers, chiefly horizontal (or rather inclined), and a few vertical. The effect of this was that when the gas reached the engine-house it was never less than 90°; and in going through the exhausters its temperature was raised by perhaps another 15° or 20°. Then it passed to the Livesey washers, and was there washed with a liquor of about 90° temperature; and the same in the tower scrubbers. Up to this point there was no difficulty. The gas then passed into the Kirkham, Hulett, and Chandler washers, where it met water at the temperature of the atmosphere; and from this point forward naturally the trouble began. Between it and the purifiers there was thrown down at certain times a volume of naphthalene that caused serious inconvenience. Every autumn they had to clean out three gasholder mains between the works and the holders at the Kennington Lane station—one a 30-inch and two 24-inch—each about one-third of a mile in length. From these three mains they got 60 tons of naphthalene as the minimum; while on the works he estimated that they had at least another 40 tons in a black and unsaleable condition, which they cleared from mains and steamed out of the washers and scrubbers. He wished to point out to the advocates of hot condensation that at Vauxhall they complied altogether with the specification of the pioneers in the industry. The gas of sixty years ago was recommended to be cooled very gradually; the hydraulic main to be kept hot; the intervening condensing apparatus to be kept at a considerable temperature; and the condensation to be terminated at 60° or 70°. This was with the view of keeping up the illuminating power. Gas was then made at a lower temperature, highly enriched with cannel, and the illuminating power was the Alpha and Omega sought for. Mr. Bowditch even went further, and recommended that gas should be put into the holder at 90°; and the sole limit he (Mr. Bowditch) saw was the adverse influence such high temperatures might have on the subsequent processes of purification. Now, the high temperature of the gas at Vauxhall did not affect the purification, which was as good and as cheap as at other places. It was impossible to get the strength of the liquor above 5 or 6 ounces as distilled; and this led to considerable expense for lighterage and fuel. He (Mr. Browne) would contrast with this the state of things at Bankside—and he had some right to say something about this, though he had nothing to do with the manufacture, because the Bankside gas went to Kennington to be distributed with that which was made at Vauxhall. The Bankside condensation was the exact opposite of what he had been describing. The gas passed to the exhauster by as short connections as possible from the retort-house, and was delivered to a condenser on the pressure side at a temperature about equal to that of the inlet of the Vauxhall condensers. Then it went into a water-tube condenser, through which large volumes of water were pumped at the temperature of the day—the cold water, of course, flowing in the reverse direction to the gas. When the gas had passed through, its temperature had been reduced from 130° or 140° to within a few degrees of the temperature of the water. This he imagined was very far in the direction of what might be called drastic and sudden condensation; and it should be followed, one would imagine, from the experience of some people, by considerable differences in the illuminating power of the gas made at the two stations. With regard to illuminating power, the gas at Bankside was slightly higher than that made at Vauxhall. They worked high heats, producing a fair make of gas per ton with Newcastle coal. The average illuminating power at Vauxhall was $14\frac{3}{4}$ candles, tested by the table or Referees' photometer; and the make was 11,000 cubic feet or upwards per ton. At Bankside the gas was close upon 15 candles as an average; but there they had inclined retorts, while Vauxhall had horizontals. The make per ton was not quite so high at Bankside, on an average; but the Vauxhall make might be said to be from 11,000 to 11,200, and at Bankside from 10,800 to 11,000 cubic feet. The next point he wished to notice was that the calorific power of the gas was rather more favourable in the case of Bankside. There had been no loss in illuminating power, and rather a gain in calorific value. Then came the vexed question of naphthalene. Before the introduction of this drastic system of condensation, the Bankside works were inconvenienced by naphthalene to just the same degree as those at Vauxhall. But drastic condensers had now been in use for some four years, with the result that naphthalene had disappeared from the works. There was a main between Bankside and the gasholders at Kennington, and naphthalene was not deposited therein. It seemed to him that there was no unsatisfactory point in connection with this; and therefore they would not be surprised to hear that within a very few months the whole condensation system at Vauxhall was to be swept out. The tar at Bankside was sent to the East Greenwich tar-works; and he believed it was slightly better, notwithstanding that the illuminating and calorific power were fully as high.

The President remarked that there were about 400 cubic feet less gas taken out per ton of coal.

Mr. Browne said this was scarcely the case. In one works the make was from 10,800 to 11,000 cubic feet, and in the other from 11,000 to 11,200 cubic feet. Such personal experience as he had given was, he thought, of more use to the members than any theoretical remarks which one was tempted to make on the very interesting paper before them. He would conclude by saying a word in connection with the counter-current which played so prominent a part in the paper, because he wished to suggest to Dr. Colman a doubt which had entered his mind with regard to it. He thought that at the temperature of the hydraulic main—say, 140°—the gas was not saturated, even in the case of Newcastle coal, with naphthalene. They knew that as the temperature of the gas fell it became rapidly saturated. At the cool end of the condensers, the tars and lighter oils would absorb the naphthalene. When this liquid reached the hot end, approaching near to the source of heat on the counter-current principle, would it not give up to the hot gas which was unsaturated the naphthalene it had already absorbed? Before sitting down, he wished to congratulate Dr. Colman on his happy adaptation of a very simple piece of mechanism to the end desired. He was inclined to think Dr. Colman was far too modest in his statement of what had been done. He (Mr. Browne) believed Dr. Colman had devised a simple piece of apparatus,

IMPORTANT TO GAS ENGINEERS

A Lifeless, Inefficient Burner and a Poor Mantle nullify the best efforts of the Gas Engineers to fight the Electric Light.

Telephone:
8585 CENTRAL.

TRADE MARK.

Telegraphic Address:
VIVIDATA, LONDON.

THE . .

"VIVID"

Patent Incandescent

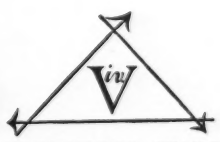
BURNER

(For Domestic and Street Use)

is built on principles which, in the nature of things, is bound to produce a Great Light.

The Latter is distinguished for Steadiness, Fullness, and Brilliancy. It is always Reliable and under Perfect Control. In conjunction with the

"VIVID" PATENT MANTLE,



REGISTERED STAMP ON EACH MANTLE.

the Light is Magnificent and Lasting.

THE 'VIVID' PATENT INCANDESCENT MANTLE CO.,

Office & Warehouse: 60a, WILSON STREET, LONDON, E.C.

P.S.—Our "FIREFAST" FORK is Straighter and Stronger than any other.

WILLIAM SUGG'S PATENT
INCANDESCENT GAS-LAMP
The "NEWARK,"
PERFECTLY VENTILATED,
WIND, RAIN, & DUST PROOF.

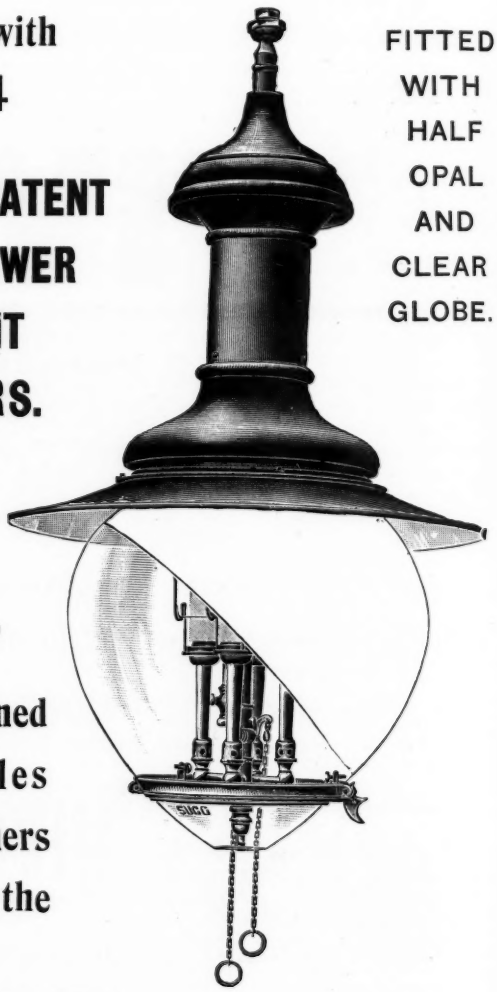
Specially designed for use with Incandescent Gas-Burners, and are the Best and Cheapest Lamps on the market.

Length over all, 3 feet 2 inches. Width over all, 1 foot 8½ inches.

FITTED WITH CLEAR GLOBE.

Can be Fitted with
2, 3, OR 4
OF
WILLIAM SUGG'S PATENT 140-CANDLE POWER INCANDESCENT GAS-BURNERS.

The
"NEWARK"
Glass can be cleaned and New Mantles fitted to the Burners without lowering the Globe.



FITTED WITH HALF OPAL AND CLEAR GLOBE.

Suitable for Lighting Shop Fronts, Market Places, Wharves, Railway Stations, Sheds, &c.

PLEASE WRITE FOR LIST NO. 11.

WILLIAM SUGG & CO., LIMITED.

VINCENT WORKS,
WESTMINSTER, S.W.

which would make all the difference to them in the future, and would probably lead to the wiping out of the controversy between the advocates of hot and cold condensation. He hoped all difficulties might be shortly cleared out of the way. It was quite right that tar fog was of the greatest use to them. They could not afford to do without it so long as its composition was right. But the thick tar which was carried right through the system was robbing the gas of constituents which ought to be left in it; and eliminating that tar would be all to their advantage.

Mr. R. Bruce Anderson (London) said he thought there could be no doubt that the author had obtained certain results; but he was not satisfied that he had given the proper reasons for them. The velocity of gas entering the mains for a consumption of a million cubic feet per day, with 18-inch connections, would only be five miles an hour; and his feeling was that the gas went from the inlet straight away by short-circuit to the outlet, and would not have that vortex action set up to which Dr. Colman attributed the results. As he understood the apparatus, it was simply an empty condensing vessel, and there should be practically no back-pressure. It was said that there was an inch of back-pressure; but he should like to know where the author had taken the two readings. He presumed at the inlet side of the valve controlling the gas entering the chamber, and also at the outlet. If so, was it not a question of squirting the gas under pressure, and wire-drawing it in the chamber, instead of a whirling action being set up, which caused the deposition of the tar on account of the particles being attached to the side of the vessel?

Mr. T. Glover (Norwich) said it was refreshing in these days to have a paper on the subject of condensation, and to hear someone of Dr. Colman's ability deal so well with it. He congratulated him on the application of his beautiful piece of apparatus. The chief contention about the paper was whether it was wise to dry the gas previous to condensation, or whether they ought to attach importance to the tar fog, which Dr. Colman did in the first place, and then seemed to minimize it afterwards. He (Mr. Glover) had had a special experience lately with tar fog. His carbonizing works and water-gas plant were removed about a quarter of a mile from the purifiers, and for some time the crude water gas and the coal gas contained a very large quantity of this fog. It was found that it washed out the naphthalene very perfectly from the coal gas. This was discovered by analyzing the tar from the syphon drips, when it was found, at the end of the quarter of a mile, to contain about 24 per cent. of naphthalene salt. This showed him very distinctly the important washing effect of tar fog. The author mentioned this, and gave it due weight. They had all been accustomed to test crude gas with bits of paper held in a stream, and to see the fine particles impacted on the paper. Now, crude coal gas, it was very well known, contained a good deal of tar fog. As the gas reached the condensers, the tar fog, condensed on to the cooled surfaces, ran down, and became saturated with naphthalene when there was sufficient for the purpose contained in the gas. The chief trouble with many was that there were not sufficient liquid products in the condensers to carry out the washing that was required. The condenser was more than a cooler; it was an apparatus wherein a good deal of absorption of vapour, desirable and undesirable, took place. But the value of this was recognized many years ago, when hot frictional scrubbing was resorted to in order to remove the heavy oils and prevent their absorption of benzene at a later stage. Its importance was not so great now as it was twenty years ago, when illuminating power had more consideration; but it had a relation to the subject of the paper. Dr. Colman proposed to remove the heavy oil particles at an earlier stage, while the gas was at 130° or 140°. He (Mr. Glover) was sorry to differ from Dr. Colman; but he believed he was wrong in seeking to remove these heavy tar molecules at an early stage, because he took out the oil that was a solvent of naphthalene. Frictional condensation did go on, in the ordinary course, in gas-works; and he believed the light oils at the end of the condenser were doing very important work, as well as the heavy oils in the inlet. Therefore to his mind it seemed unnatural to seek to remove these heavy tar particles by the author's beautiful apparatus. With regard to condensation generally, and working hot or cold, they regarded a certain piece of apparatus as a condenser; and if they operated it so that it did not act as a condenser, the work was naturally thrown on to the scrubber, which therefore acted as a condenser. But more than this, the filling materials of the scrubber became coated with absorbents of naphthalene until they were blocked, and perhaps this accounted for some of the temporary success which had followed the working of the condensers hot.

Mr. C. E. Botley (Hastings) said he agreed with what Mr. Browne had stated about the different modes of condensing, as he had had an experience somewhat similar; and he related it in a paper he read some years ago. He had very imperfect condensation, and an immense amount of naphthalene went right up to the gasholder, into the scrubbers, washers, and mains, and even to the bottoms of the purifiers; so that they found it necessary to alter the whole system, and bring it down to more perfect condensation. When this was done, all trouble ceased. He also agreed to a great extent with what Mr. Glover had said. He thought the drastic process of removing all the tars at the point Dr. Colman proposed was hardly necessary. In the foul-main the usual practice was to let the tar go off by gravity at various points; and he thought this accomplished all that was desired. In many cases they found, where comparisons had been made, it was demonstrated that the improvement, at any rate in his case, reduced the naphthalene to a point which put an end to any difficulty at the works. The question of its deposit outside the works was different, and he did not propose to enter upon it, except to say that, whatever might be done, the conditions of manufacture, temperature, and coal would vary to such an extent from time to time that if gas managers wanted to be free from naphthalene they must employ some extraneous means beyond that afforded by the solvent property of the tar in the course of manufacture.

The President said the view on his side of the table was that they should not discuss the question of naphthalene too much, because it depended on the condensation whether or not too much was taken out of the gas. One might take out the naphthalene and the illuminating power; the *crux* was to leave the maximum illuminating constituents and at the same time have as little inconvenience as possible from naphthalene. He could not help thanking Mr. Browne especially for the interesting contribution he had made from his own personal experience. On the previous day, he (the President) had alluded to the great value of personal observations faithfully recorded by observers in their daily work, apart from theory; and he was sure Dr. Colman would agree that one could best base his theories on the consensus of observation in general practice. He could not help thinking that some of Mr. Browne's troubles arose from the fact that not only were the works built on the theories of sixty years ago, but probably some of the apparatus remained on the scale of that time; and if they were making 13 million cubic feet of gas a day from works originally built for 4 or 5 millions, it was not astonishing that difficulties were met with. He had experienced many of these difficulties himself. He had known troubles on Sundays, with gasholder pipes that were too small to allow a man to go down them, and the naphthalene had all to be fished out; while sometimes it got baked into a rock, when they steamed it too much. He remembered that they found their condensers were too small by discovering tar in the bottom of the purifiers. In those days they had not Dr. Clowes looking after bisulphide of carbon, or they would have been in the Police Court every week. One did get a little information by going about, and perhaps having to do with gas-works abroad as well as at home. In many foreign gas-works they had little or no condensing plant, but had Pelouze separators, in which the molecules of tar were thrown on to a plate and attracted each other. But in every case these machines had to be cleaned at frequent intervals. One gentleman said that his Pelouze machine went on with uninterrupted action; but at another friend's works they had to clean them out every three or four weeks. The invention of some moderate condenser would probably save a great deal of the cleansing. He had mentioned once or twice a little gas-works at Epsom where, following an idea he had sketched out several years ago, they simply put up a pipe which ran backwards and forwards along a wall. They took care to separate the tar flowing from the hydraulic main—the thick heavy tar—into a separate well, and it ran away; but they got the lighter tars in contact with the gas through this pipe. For thirty years these works had not had any naphthalene anywhere; they had not even a machine for taking it out. No

consumer had ever complained. On the other hand, in London works, where so large a quantity of gas was made at high pressure and with different apparatus, he found immense advantage from the use of water gas. Being employed for enrichment, it naturally had to be fully saturated with oil, and there was always a little carried over. This unfixed oil, as he might call it, passing on, and being condensed in the system, kept it clear of naphthalene. With regard to the apparatus now shown, he could not help assuring Mr. Anderson that one really did get that velocity of vortex upon which Dr. Colman relied. He (Mr. Jones) expected they would have, as they did in the old running machine now used for drying sulphate of ammonia, a centrifugal action, which threw out the particles of tar, which attracted other particles, and they flowed down. He thought himself that it was not quite clear but that one would get a direct flow from the inlet to the outlet. Gas was a very elastic fluid. Water, being inelastic, would flow round and round. But elastic fluid was different. He thought that, to improve this apparatus, and make it certain of accomplishing its object, a spindle should be put down, running at high speed, with fans upon it, which would throw the gas against the sides. This would made the vortex action a dead-certainty; whereas at present one could only rely on the speed of flow to produce it.

Mr. Browne said he was glad the President had referred to the point that the condensers at Vauxhall were overdriven. The productive power of the works had grown to be greatly in excess of the condensing surfaces.

Dr. Colman, in reply, said, with regard to the President's last remark, referring to those made by Mr. Anderson with reference to the existence of vortex action in the centrifugal separator, there was no doubt whatever that this did exist, and was not due to any difference of pressure, as suggested by Mr. Anderson, nor to capillary attraction, because the apparatus was equally effectual with solid particles, such as flour dust or other dust of the finest size. Similar apparatus was used in flour mills and for other purposes. The passage of the gas sometimes caused a humming, and a musical note could be distinctly heard a good many yards away.

Mr. Anderson remarked that this might be due to the different velocity of the gas passing through the pipe.

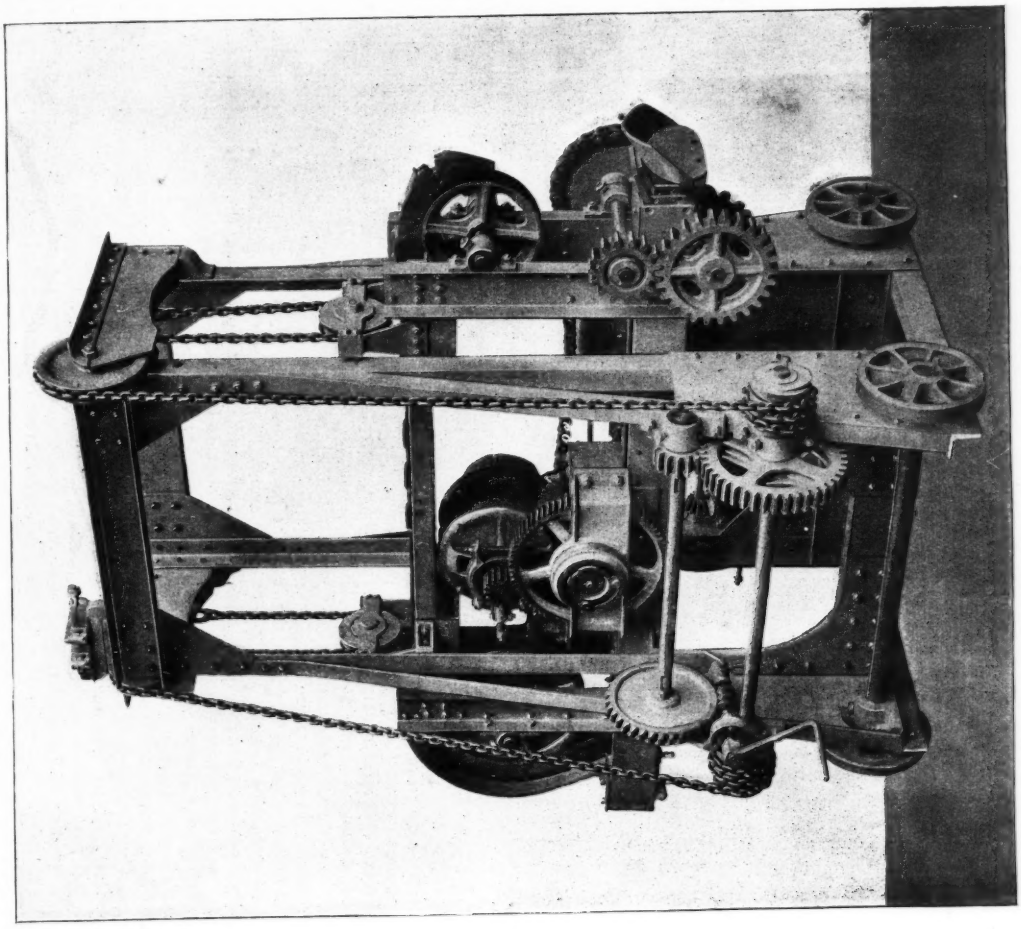
Dr. Colman said, even with the lower speed in passing through the large chamber, the velocity was far above the rate at which dust would deposit. Dealing with tar was easier than with dust; the gas coming away free from tar, which flowed off in a continuous stream. To go back to Mr. Townsend's observations, they certainly seemed to confirm his own results, though they were brought out in a different manner. He fully agreed with his views; and certainly the results obtained so far at Tottenham seemed to confirm them, although they had not yet lasted long enough to enable a definite conclusion to be come to. Mr. Glover and Mr. Botley made some remarks with regard to heavy tar fog—as to whether it was valuable or not. He was a firm believer that tar fog was most valuable, but all depended upon its nature. If they had a tar fog which already contained 20 per cent. of naphthalene, his view was that this had better be removed from the gas. The action of the fog on the gas would, if the gas contained no naphthalene, and the temperature was 60°, be to actually increase the quantity of naphthalene. In fact, if they had only 10 per cent. of naphthalene in the tar at 60°, when gas that was free from naphthalene was passed through it, it would also take up 15 grains per 100 cubic feet. If they allowed the tar fog to go forward, he agreed that it would dissolve a certain amount more; but, on the other hand, it would at the same time dissolve out the light oils, such as benzene and toluene, which they wanted to keep in, and it would not reduce the naphthalene. It was, of course, not yet capable of definite proof, but he held strongly to his opinion; and no doubt Mr. Glover and Mr. Botley would both hold to theirs. The question could only be determined by further investigation. With regard to one matter to which the President had referred—that practical experience was of great importance—in his view the only assistance of theoretical views was that they helped one in determining what lines to work upon and what determinations to make. Any theoretical view not founded on and tested by experimental investigation was valueless. Mr. Browne had asked whether it was possible, when using the counter-current, that the naphthalene which had been liquefied at the lower temperature, and was flowing back to the point where the temperature was higher, would give up naphthalene again under these circumstances. He had no doubt it would. At the same time it was not only naphthalene that was flowing back, it was naphthalene together with the other condensed products of lower boiling-points—xylene, toluene, and so forth. The action of heat on the mixed liquid was that it revolatilized the lowest boiling-point constituents to the greatest extent; and the result was that at the hot end a certain amount of naphthalene was re-introduced into the gas. But a still larger quantity of xylene, toluene, and benzene was introduced, which again separated out as the gas passed through the condenser; and these being there in larger quantity, the naphthalene was more completely removed. He thought the work Mr. Bell had been doing at Derby, in connection with adding hot tar to the first limb of the condenser, was a case in point, and would exemplify his meaning. He pumped coal tar into the top of one limb of the condenser, and it flowed down, gradually getting hotter. Whether this would have a good or a bad effect would depend upon the composition of the tar, just as in the case of tar fog. The effect on hot tar put into the condenser was that its temperature rose, and that the vapour pressure of its constituents increased; the lowest boiling constituents going off in the greatest proportion. The probability was that the tar, in passing through, gave off naphthalene actually to the hot gas; but it gave a great deal more—toluene, xylene, and so forth—which then separated out in the cooler portion of the condenser, simultaneously washing out naphthalene, giving the more favourable results which Mr. Bell had obtained. Mr. Bell told him himself, some short time ago, that if the tar was treated two or three times, it had no longer any beneficial effect. When the light oils were driven off by putting it through the condenser once or twice, so that not a sufficient quantity was left, the passage of tar had no additional effect in removing naphthalene. One remark, in conclusion, which bore on what Mr. Glover said—that the trouble they had was not having sufficient oils present in the condensers to effect the removal of the naphthalene. He agreed with this, especially with Durham coal. Therefore one object he had in view with this centrifugal separator was to obtain a source from which he could add such oils to the gas. After the tar fog had been taken out by the separator at the condenser inlet, that which separated later was a thin oil, and contained large quantities of light oils, but amounted to only about one-third of a gallon per 10,000 cubic feet—a quantity which was easily handled, and from which the light oils could be readily driven off. His desire was to utilize this tar, and drive off the light oils from it back into the condenser inlet, or some other point, and thus ensure that there was always present in the condenser during the process of cooling a larger quantity of these oils than was actually being made by carbonization in the retorts.

DE BROUWER STOKING MACHINERY AT DERBY.

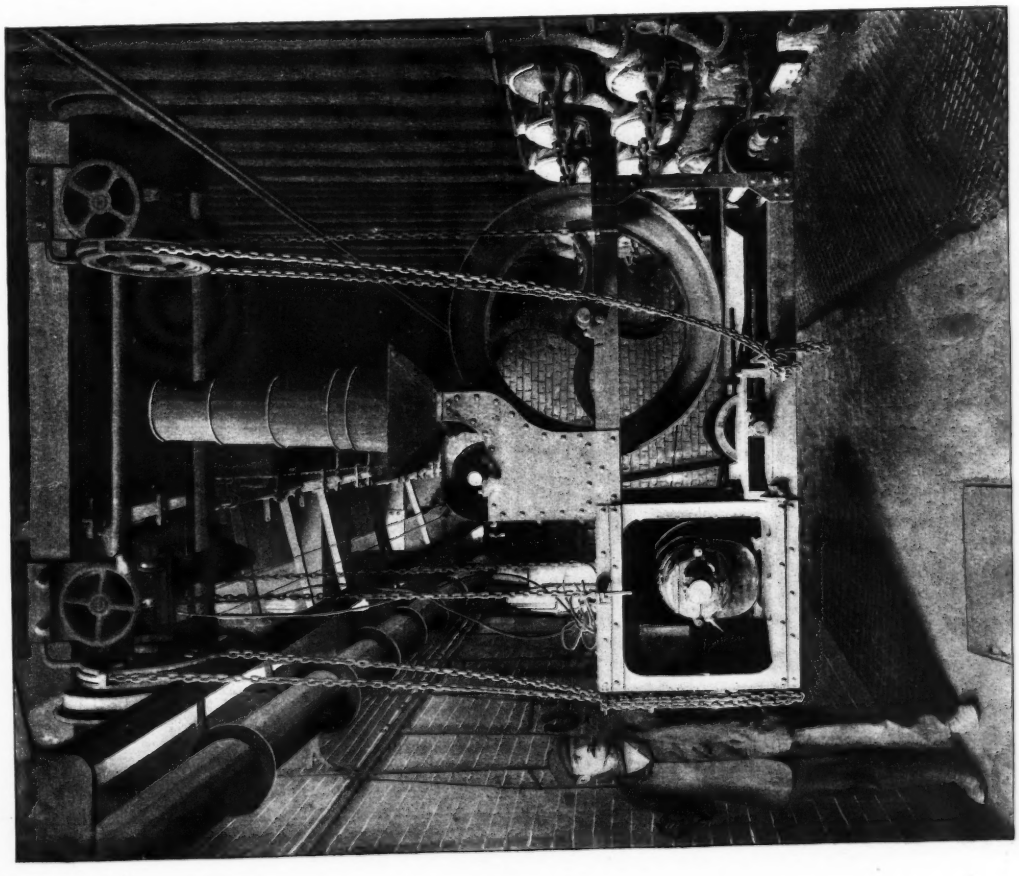
By J. FERGUSON BELL, of Derby.

Before entering upon the subject of this paper, the author desires to express the indebtedness of the gas industry to Mr. John West and the late Mr. William Foulis for their persistent efforts towards the introduction and perfecting of machinery for charging and discharging gas-retorts, in place of laborious and trying manual labour. There is no doubt that where West or Foulis machines can be introduced on a scale sufficient to keep them reasonably employed, they are a paying investment; and it is not the author's intention to draw comparisons, invidious or otherwise, between the De Brouwer and other stoking machinery or inclined retorts, but simply to give a description of the plant installed at the Cavendish Street station of the Derby Gas Company, along with the results obtained by continuous working over the past seven or eight months.

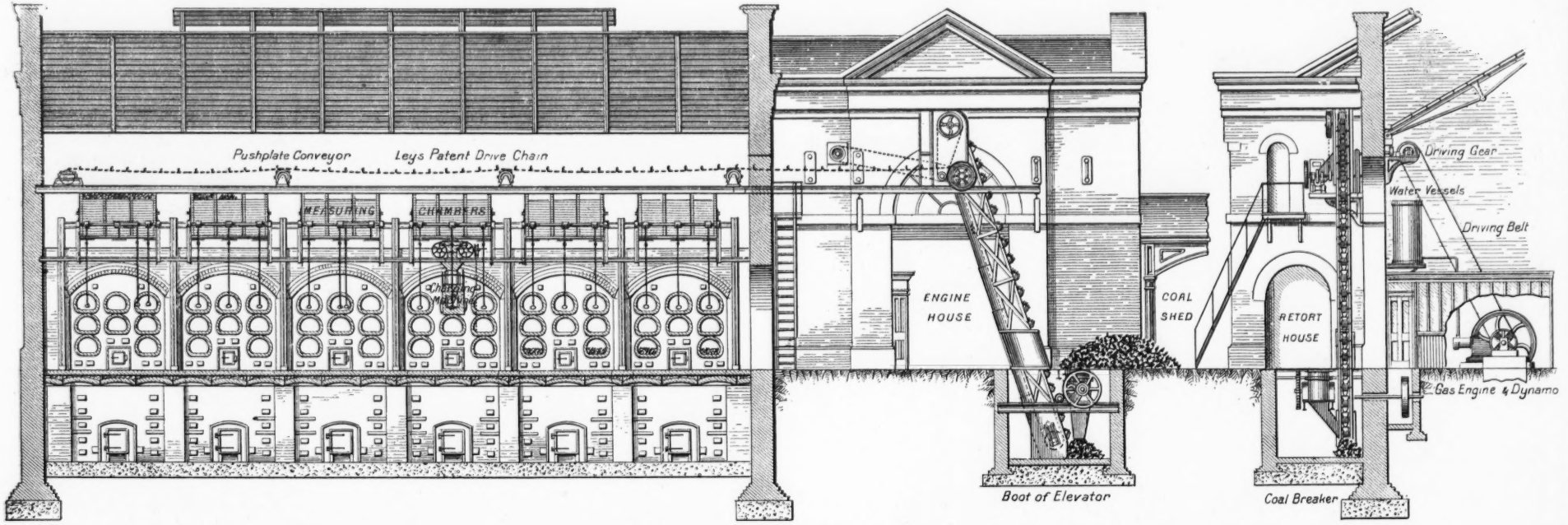
It is now some fifteen months since the author went over to Bruges to inspect the De Brouwer charging machine at work there; and he was so impressed by its simplicity and ease of manipulation, the small power taken to work the machine, its smoothness in working, and the regular even charges, that he decided it possessed sufficient merit to warrant a trial installation being erected in this country on a scale sufficient to demonstrate its practicability or otherwise. Arrangements were made with Messrs. W. J. Jenkins and Co., of Retford (who have acquired the British patent



THE "JENKINS DE BROUWER" DISCHARGING-PUSHER.



THE SUSPENDED DE BROUWER PROJECTOR AT DERBY.



GENERAL ELEVATION AND SECTION OF THE CAVENDISH STREET RETORT-HOUSE, WITH COAL FEEDING ARRANGEMENTS.

rights), to erect a De Brouwer charging machine at Derby, and later an order was placed with the same firm for a discharging machine. The description and working of both machines, and results obtained, will probably be best considered under three heads:

1.—Description of the charging machine, with auxiliary plant and method of working.

2.—Description of the discharging machine and operation of same.

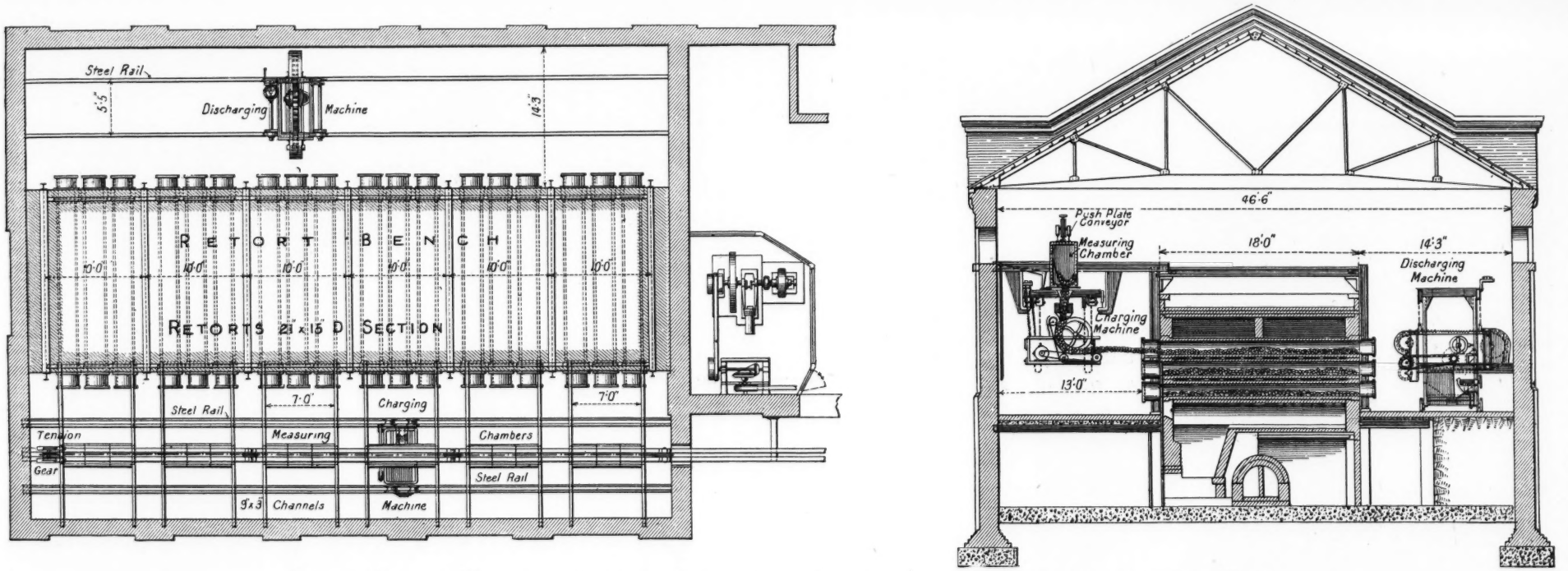
3.—Results obtained as compared with hand labour.

I.—THE CHARGING MACHINE.

The auxiliary plant generally consists of the usual coal-breaker, with bucket-elevator and conveyor, which, in the case at Derby, is of the push-plate type, carried on top of the overhead measuring chambers, all of which are driven by a 13½-brake horse power gas-engine from countershaft and belt pulley on the fly-wheel side of the engine. On the other side, is a four-pole direct-current dynamo, of 5½ kilowatts output, connected to the crank-shaft of the engine by a Zodel-Voith flexible coupling. In front of each bed of retorts is a small overhead storage-hopper, divided by vertical plates into three compartments so as to form separate measuring-chambers large enough to hold coal sufficient to charge one through retort; there being thus one measuring-chamber above each vertical line of retorts. These measuring-chambers are open at the top, and are emptied by means of a sliding bottom door actuated by balanced levers. The details of the construction of elevator, conveyor, and overhead measuring chambers are clearly shown on drawings Nos. 1 and 2; and being the ordinary type generally used where stoking machinery or inclined retorts are installed, do not require any further description. The dynamo terminals are connected to a small switchboard having double-pole switch and cut-out, voltmeter, and ammeter. From the switchboard the current is conducted, by two overhead bare copper conductors, to motor on the charging machine by a sliding contact; the E.M.F. being about 110 volts.

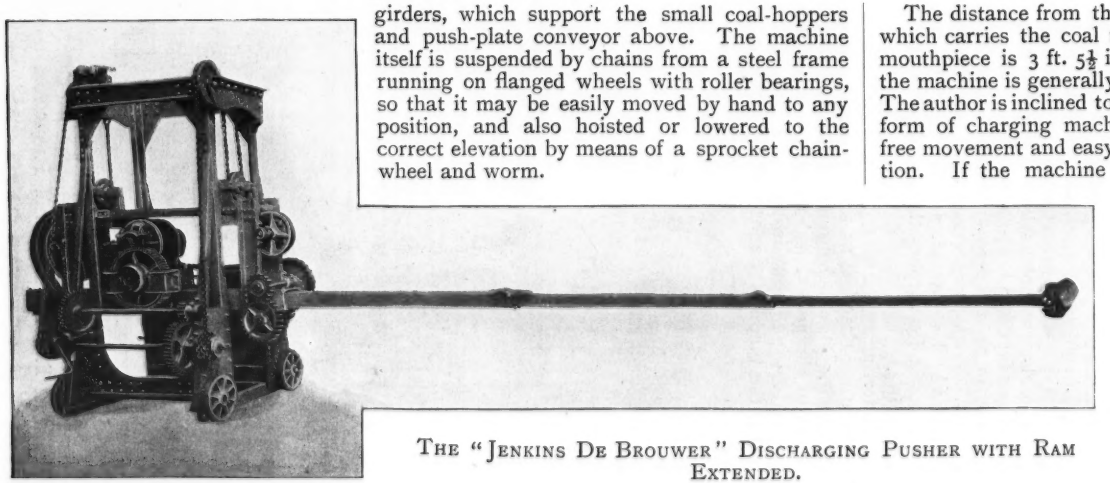
The "D.B." coal-projector, as made in England, consists of a steel frame carrying a large grooved pulley, three band pulleys for carrying a broad band, a driving motor, and a telescopic feeding shoot. The front band pulley is adjustable by bearings which can be moved by adjusting screws in sliding brackets carried on the frame of the machine, so that the proper tension may always be kept on the broad belt if it should lengthen in the course of working, or by wear. The three broad pulleys are on the inside of the band; but the large grooved pulley is on the outside of it, and the band passes about one-quarter of the way round its circumference, bearing on the two flat surfaces of the periphery of the pulley, and so driving the latter at the same speed as that of the belt. Although there is no virtue in the particular dimensions of the grooved pulley, as it can be made to vary with different conditions, it may be stated that the pulley in use on the Derby machine is 1 metre (39·3 inches) in diameter by 15 inches wide on the face; the groove being 8 inches wide and 3¾ inches deep. For wider retorts or larger coal, wider and deeper grooves would probably be used; and for charging small retorts closely built in the setting, two or more could be charged at the same time by having two or more grooves on the pulley at the desired centres.

The charging machine travels in front of the retort-bench on overhead rails carried by hanging brackets from cross



General Plan and Section of Cavendish Street Retort-House, showing Projector and Discharging Machine.

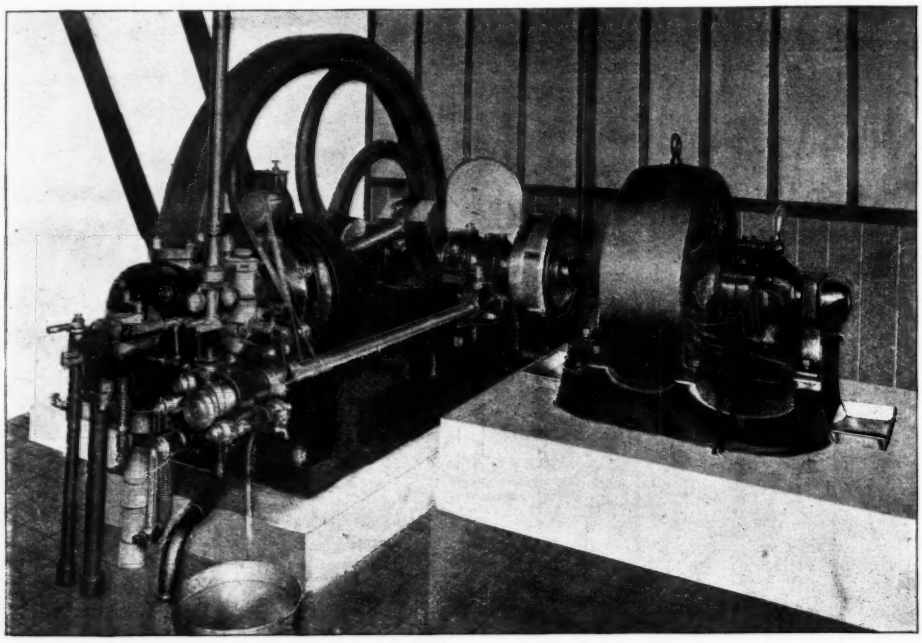
girders, which support the small coal-hoppers and push-plate conveyor above. The machine itself is suspended by chains from a steel frame running on flanged wheels with roller bearings, so that it may be easily moved by hand to any position, and also hoisted or lowered to the correct elevation by means of a sprocket chain-wheel and worm.



The "Jenkins De Brouwer" Discharging Pusher with Ram Extended.

The distance from the end of the broad belt which carries the coal to the face of the retort mouthpiece is 3 ft. 5½ in.; and the front end of the machine is generally elevated about 2 inches. The author is inclined to think that the suspended form of charging machine is best, as it allows free movement and easy adjustment to any position. If the machine runs upon rails on the retort-house floor, with overhead storage hopper carrying its own supply of coal, it necessitates a motor for travelling, which adds expense and slight additional complication; and also, if rigidly fixed, a machine of this character does not appear to adapt itself so readily for good retort charging.

The coal is usually supplied to the projector from some kind of measuring-chamber, so as to ensure charges of a definite weight. The measuring-chamber is by no means essential, though it is desirable; but if the coal varies widely in size—sometimes being nutty, and at other times fine slack—the charges would probably be irregular if the machine-man had no check to guide him in putting the same weight into each retort. The measuring-chamber is adjustable by means of a hinged plate inside, by which the capacity may be increased or diminished within certain limits, of from 5 to 7½ cwt. A different form of measure, the author is informed, is used on large machines which carry their own supply of coal, in which there are revolving blades passing a given quantity of coal at each revolution, and are motor-driven in such a way that the motor only runs for a certain predetermined number of revolutions and then stops; the number of revolutions being adjustable by means of an electric cut-out arrangement. This kind of



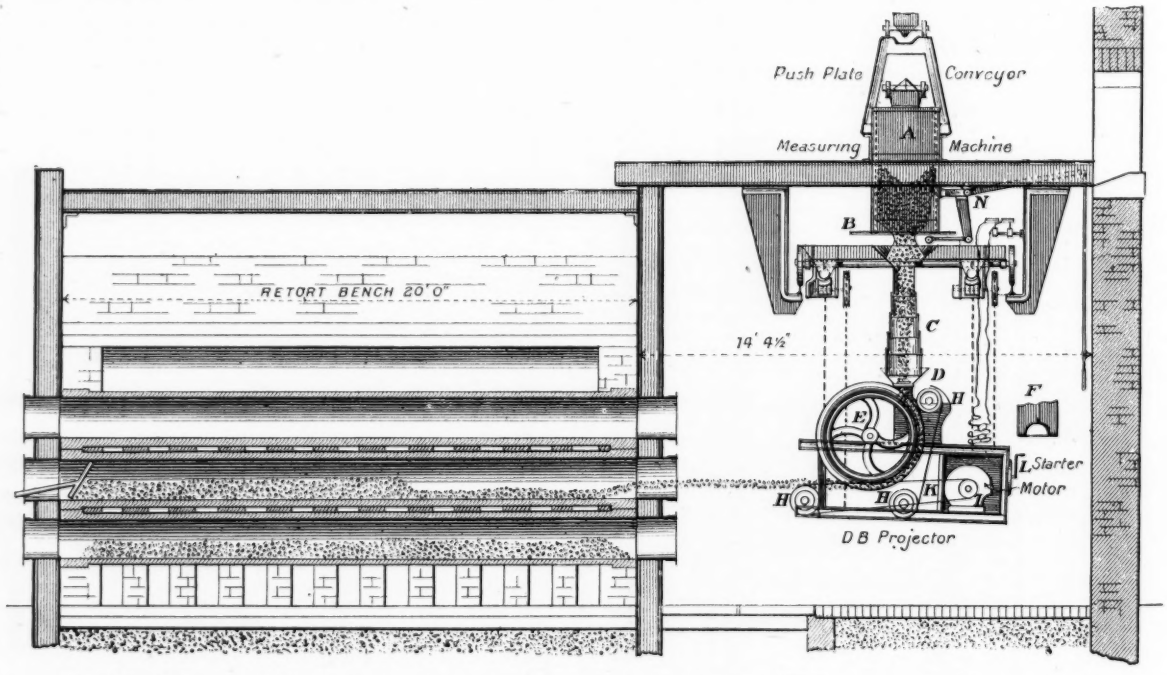
The Gas-Engine and Dynamo for Operating the Coal Plant and Projector.

measure may be useful in cases where the coal is of an exceptionally large size, or where cannel is used, as this feeder would not only pass the lumps regularly, but also keep the contents agitated and loosened, and prevent bridging over, which might otherwise occur and stop the flow.

The electric motor which drives the projector is of the enclosed type of 3 brake horse power. It is fixed at the end of the frame, and drives the front broad pulley by means of a belt. There is a starting resistance fitted with a magnetic overload release attached to the back of the motor-box, and a rheostat for varying the speed of the motor during the charging.

Referring to drawing No. 3 (below), A is the overhead measuring-chamber as used at Derby, with the conveyor above it. B is the bottom sliding door for opening the chambers to charge. C is a telescopic shoot to keep the dust from blowing about owing to draughts in the retort-house. D is the tundish or spout of the machine, to conduct the coal into the groove of the pulley. E is the large grooved pulley with the belt encircling about one-quarter of its circumference. F is a cross section of the rim of the pulley, showing the belt G, and the space into which the coal falls. H are the pulleys for carrying the broad belt. I is the motor; K, the driving belt; L, the starting apparatus; M, the variable speed rheostat; and N, the levers for opening the bottom doors of coal-hoppers.

Operation of Charging.—The operation of charging is as follows: Assuming that the overhead measuring-chamber has been automatically filled by the conveyor above, the operator first moves the handle of his speed rheostat into the position necessary for giving the broad belt the speed required to project the coal to the end of the retort, and so make the desired thickness of charge. The position on the dial to which the handle usually points is indicated by a mark, and is such as to give a speed suitable for the average charge for the size of coal used. For ordinary broken coal, the



The De Brouwer Projector, showing the Feed of the Charge of Coal to the Band and the Projection of it into the Retort.

speed of the grooved pulley lies in the neighbourhood of 220 revolutions, giving a peripheral speed of about 2300 feet per minute; and variations in the size of the coal require slight differences in the speed at starting—slower for clean, large nuts and coal, faster for small and slack. The power required to work the machine when charging varies from 22 to 30 ampères at 110 volts. The lever controlling the outlet of the measuring chamber is then pushed up, opening the bottom door; and the coal falls directly in the groove of the pulley and into the space between it and the belt. As the latter, and the pulley, are running at a greater speed than the velocity acquired by the coal in falling until it strikes the belt, the coal is gradually accelerated in speed. Hence it will be seen that this is a simple application of Newton's first law of motion, which asserts the inertia of matter. This law begins to operate from the moment the coal strikes the belt, when the stream of coal falling vertically from the measuring-chamber comes in contact nearly longitudinally with the belt, and which immediately supplies a deflecting force tending to deflect the coal more and more out of its vertical course; and the reaction of the coal causes it to lie quietly on the band, instead of scattering in all directions. The principal use of the groove is to keep the coal from flying about before it has come to rest on the band. The operation of bringing the coal to the required velocity is therefore distinctly not centrifugal.

As soon as the coal on the belt reaches the end pulley, the belt suddenly changes its direction, and Newton's law comes into force again; the coal, tending to continue in its straight line of motion, leaves the belt and goes directly into the retort in a continuous stream, like water from a hose pipe, and practically no particles diverge from the stream, because there is no impressed force in front of them tending to deflect them sideways, up or down. The stream, of course, is under the influence of the force of gravity, which gradually bends it down until the coal touches the floor of the retort; and having a considerable horizontal velocity, the coal only comes to rest when the whole of the energy has been absorbed by the friction of sliding, unless some obstruction is encountered.

An obstruction, in the form of a stop of some kind, is put in the way of the coal at the far end of the retort, and the energy is thus dissipated—partly in what is known as shock, and the remainder in lifting the coal a certain height in opposition to gravity, and this height gives the thickness to the layer. So long as the initial speed and the sliding friction remain the same, the layer will be of even thickness; but if either of these vary, the thickness will alter proportionately. Now, as the charge is put into the retort, the length over which the particles of coal have to slide gradually diminishes; and if no change in speed or elevation were made, the layer would gradually thicken up from the far end to the mouthpiece nearest the machine. There are several ways of preventing this; but the simplest—the one used at Derby—is to gradually slow-down the motor, so reducing the initial velocity of the coal as the charge approaches the machine. It is a good plan to have the layer of coal slightly thicker, if anything, in the middle of the retort rather than at the ends; and this is accomplished by leaving the initial speed of the belt unaltered until nearly half the charge is put in, and then slowing-down as the charge approaches nearer the mouthpiece.

The whole operation of charging a retort 18 feet long takes from 20 to 25 seconds, and may be done more quickly if desired. While there is no reason whatever why the slowing-down of the motor may not be done automatically, yet the operation is so simple and so easily performed that, in the author's opinion, it is best left to the attendant—more especially when the coal used is of constantly varying size and class; for each class would require an adjustment to be made to the automatic apparatus to suit, and this would cause a waste of time. There is little reason to fear bad charging from want of attention on the part of the operator; for if he neglects his duty, the layer remains good, but perhaps short of reaching the mouthpiece end, thus showing at the next draw who was to blame and what the trouble was. The measuring-chamber is of great use in this case by limiting the charge and causing it to come short of the mouthpiece.

II.—The Discharging Machine.

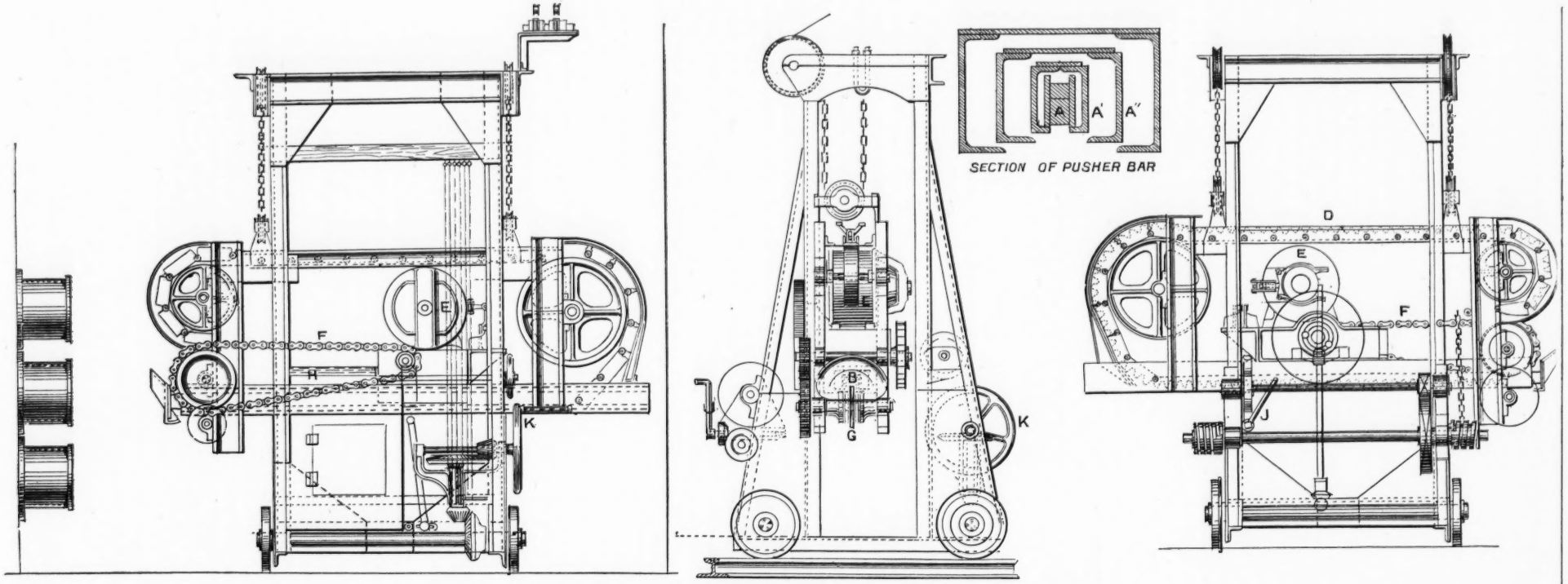
This may be called a "Jenkins De Brouwer" machine, and is not quite so simple in construction as the projector; but as all its motions are comparatively slow, the slight extra complication it is hoped will not be any cause of trouble—this machine only having been recently brought into use.

Owing to the north retort-house at the Cavendish Street works being but 46 ft. 6 in. wide inside, and containing six through beds, and as the proposed extension of six more beds will complete this house, it was not considered necessary to fit the pusher with power propelling and hoisting gear, hand-gear only being used. But for larger retort-houses, the author recommends the substitution of power for this purpose. The machine consists of a strong frame of steel angles, plates, and channels, carried on two plain and two flanged wheels running on rolled joists and an ordinary tram rail let into the retort-house floor. One of the axles is fitted with a bevel wheel, which gears with a pinion on a vertical shaft geared in a similar way to a horizontal shaft having a propelling wheel and handle upon it. The hoisting is done by a simple hand-gear, communicating motion to two chain-barrels—one on each end of a shaft near the base of the machine. The chains pass to the top of the machine and round pulleys to the hanging frame, which carries the pusher bar, with electric motor and gearing for operating the pusher.

The motor is of the enclosed type, dust-proof, of 7½ brake horse power. It is fitted with a pinion on the shaft, and gears with a spur-wheel on the second motion shaft, which is carried in bearings cast in one with a box-shaped bedplate bolted to the channel guide-frame and carrying the motor upon its upper surface. The gearing box is adjustable in position, so that the pitch-chain can be tightened when necessary. On the end of the second motion shaft is placed a tappet motion, by which the stroke of the pusher-bar is limited at both ends of the stroke to prevent damage to the machine or to the motor. The tappets are adjustable, so that the strokes may be varied a little at both ends if desired, or at the front end only. They strike on levers much in the same way as the belt fork-gear for reversing a planing machine; but in this case the motion is so arranged as to release the lever of the reversing controller to its central or out-of-gear position. At the opposite end of the second motion shaft is fitted a cut sprocket-wheel which gears with a Renold's roller type chain, through which the power is transmitted by spur-gear to a rack and pinion placed near the front of the guide-frame and central with the pusher-bar. There is a magnetic brake on the motor shaft, so arranged that the current, on its way to the motor, passes round the exciting coils of the magnets, and the latter then lifts the brake off. As soon as the current is cut off by the controller, the brake acts quickly and stops the armature; thus almost instantaneously bringing the machine to rest at any part of the stroke.

The pusher-bar itself is in three lengths, arranged to telescope into each other, so as to work within the space between the face of the mouthpieces and the retort-house wall, which, in this case, is extremely limited, being only some 13 feet. The first length of the pusher-bar is made of two pieces of flat iron, with a steel rack of coarse pitch riveted between them and fitted at the end with a renewable push-plate of nearly the cross section of the retort, while the other two lengths consist of two sections formed of steel channels. The inward end of the front pusher-bar is carried on rollers for reducing the friction; and the rack is continued by means of cast-steel links made so as to be easily bent in the upward direction, but remain straight and unbendable in the downward—this being M. De Brouwer's patent sliding link chain. Each link has three teeth cast in it; and the body is so formed as to fit the inside of the portion of the pusher-bar to which it belongs. A frame formed of angles carries a pulley at each end, and a continuation of the frame passes round the end pulley near the retort-house wall, and is prolonged into the space between the guide frame and central with the pusher-bar. There is a specially formed shoe at the foot of the curve, to pick up the links of the rack. When the pusher-bars are in the guide-frame, the linked rack lies along the top groove of the frame and round the end drums. When the pusher-bars are in the retorts, the whole of the links are inside the hollow spaces of the two outer lengths of the pusher-bar.

Each length of the pusher-bar is carried in the next by means of rollers, so as to be easy to move. The rack in the front length of the pusher is so arranged that a space is left on the top of the casting and between the slide bars; this space being filled with water to keep the pusher-bars cool. The several lengths of the bar are all fitted with



THE "JENKINS DE BROUWER" DISCHARGING-PUSHER IN END AND SIDE ELEVATIONS.

automatic catches, by which they are held in position till the proper time comes for each to move. The current is supplied from two overhead wires in the retort-house to a couple of small trolley attachments fixed on the pusher, similar to the charging machine. If the retort-house had been wider, both machines would probably have been placed on the same side of the house. The controller is of the "tramway" type. The resistances are arranged so that five speeds can be used, in order that the pusher-head may be brought gently up to its work; and after the coke is in motion the speed may be greatly increased. In addition, there is an overload release or circuit-breaker to protect the machine or retort from damage in case the coke jams.

Drawing No. 4 (above) will make this description clearer. A, A', A'' shows the inner, intermediate, and outer pusher-bars. B is the renewable push-plate at the front end of the first length of the pusher-bar A. C is a steel rack of coarse pitch, which, with flat side-bars, forms the inner pusher-bar A. D is M. De Brouwer's sliding link chain; and is connected with the steel rack C. E is the electric motor, with magnetic brake on the motor shaft and pinion, which gears into a spur-wheel on the second motor shaft. F is a Renold's roller chain, to transmit power from the sprocket wheel on the second motion shaft to the spur-gear. G is the centre pinion, which gears into the rack C of the pusher-bar A or into the linked chain D with the pusher-bars A' and A''. H is the controller of tramway type. I is the wheel connected by a lever controller to operate motor. J is the handle by which the height of the pusher-bar is raised or lowered. K is the wheel to traverse machine.

Operation of Discharging.—Having been adjusted at the right height for a tier of retorts to be discharged, the pusher-bar is brought opposite a mouthpiece. The operator then moves the handle of the controller, which causes the current to excite the magnets and lifts the brake off the motor shaft. The motor then starts, and by the gearing before described the rack pinion drives the first length of the pusher-bar into the retort. As soon as the coke is in motion, the speed is increased to the maximum given by the winding of the motor; and as the first length of the pusher-bar reaches the end of its stroke, it releases the catch and sets the second length free. The rack pinion then gears with the linked rack, and draws it forward off the frame, at the same time pushing the bar forward and keeping the coke in motion. The third length is released when the second reaches the end of its stroke; and the linked rack continues to move forward at the front end while uncoiling off the frame at the back. As the predetermined length of stroke is reached, the automatic tappet gear pushes the lever of the controller back to its central or "off" position—cutting off the current from the magnets, and allowing the brake to act and stop the armature. The discharging is then complete.

The next operation is to withdraw the pusher-bar into its frame. The operator moves the lever of the controller in the reverse direction, reversing the motor; and by the action of the rack links the pusher-bars are drawn back. The linked

rack, as it reaches the curved end of the frame nearest the retort-house wall, is guided upwards and bends round inside the curved portion, and passes back along the frame over the top of the motor until the three lengths are again in the guide-frame. Just before this occurs, the backward tappet comes in contact and brings the lever of the controller to its central point, and stops the machine. All this is done in very much less time than it has taken to describe the operation; the average time required to discharge one through retort, 18 feet long, being about 40 seconds from the starting of the pusher-bar to enter the retort until the bar is again withdrawn and at rest ready for the machine to travel into the position to discharge the next retort. As already mentioned, where a large number of retorts have to be discharged the travelling of the machine and the hoisting of the pusher-bar would be done by a motor on the machine, which would then easily discharge one through retort in less than a minute. The charging-machine requires less than half-a-minute to charge a retort. Therefore, by means of both machines, retorts may be emptied and refilled at the rate of one through retort per minute.

III.—Results as Compared with Hand Labour.

The author is able to give the results of working with six beds of ⏛ section retorts, 21 in. by 15 in. by 18 ft. through, being in all 96 mouthpieces, for a period of six months' continuous work; and during this period they have produced 109 million cubic feet of gas. The whole of the charges have been put in by the "D.B." charging-machine; and there has not been any hitch or trouble of any kind. The only renewal has been the broad band which carries the coal; and an ordinary leather belt has been in use some three months with slight repairs. It will therefore be seen that the wearing of the belt is not a serious matter; and this is the only part of the charging-machine on which there is any appreciable amount of wear. The charges are well put in, and are remarkably level. With small or large nuts, it would be impossible to put them in more level or in better layers, and even with fine slack good charges are obtainable. With ordinary coal passed through a breaker, there is no trouble; and the machine is capable of dealing successfully with various grades and classes of coals.

The carbonizing results obtained with machine charging as compared with scoop or shovel charging are higher, there being, so far as can be ascertained, an increase of some 300 to 400 cubic feet of gas per ton, owing no doubt to the layers being of more even thickness and being kept well clear of the mouthpiece ends; also there is an increase in make of gas per mouthpiece, due to greater weight of coal carbonized per retort and larger yield of gas. The highest make obtained with South Yorkshire small washed pea nuts was 12,140 cubic feet per ton of 16¼-candle power gas; and the average make over three months with Yorkshire and Derbyshire coals—chiefly small pea nuts—is 11,316 cubic feet per ton of 15·79-candle power gas. To accurately indicate the actual saving effected in making 109 million cubic feet of gas in six months with "D.B." machine charging, the retorts being drawn by hand, and coke wheeled out, the author cannot do better than give an extract from a report presented to his Directors upon the completion of the first six months' use: "The saving effected in wages for carbonizing in the six months from 21st October, 1903, to 20th April, 1904, at Cavendish Street station is £455, which equals 42·74 per cent. upon the first cost of the installation." This represents a saving in wages of 11d. per ton of coal carbonized, part of which is due to the extra quantity of gas made per ton of coal carbonized and the extra weight put into each retort, along with the alteration in the method of working. Taking the actual weight of coal carbonized, apart from any increase in make per ton or advantage gained owing to alteration in method of working, the saving effected by the coal-handling plant and charging machine is 8·6d. per ton of coal. The comparative figures as between hand charging and drawing and "D.B." machine charging with hand drawing is as follows:—

Hand Charging and Drawing on Six Beds.

Coal carbonized.
- 18 stokers at 3 tons per man = 54 tons per diem.
- Quantity carbonized per week, 54 × 7 = 378 tons.

Wages paid.
- 18 stokers at 5s. per shift = £4 10s. per diem; allowing time-and-a-half for Sunday work = 7½ days per week.
- £4 10 × 7½ = £33 15s. wages per week.

Cost per ton = £33 15s. ÷ 378 = 21·42d. per ton.

"D. B." Charging Machine with Hand Drawing.

Coal carbonized.
- 36 retorts × 6 cwt. × 4 charges = 864 cwt.
- 12 ,, × 6¼ ,, × 4 ,, = 300 ,,
- 20)1164
- 58 tons 4 cwt. per diem
- 58 tons 4 cwt. × 7 days = 407 tons 8 cwt., say 407 tons per week.

Wages paid.

8 stokers at 5s. per shift . . . =	£2	0	0 per diem,
2 coalmen at 5s. per shift . . =	10	0	,, ,,
2 machine men at 4s. per shift =	8	0	,, ,,
	£2	18	0

£2 18s. × 7½ days = £21 15s. per week.

Cost per ton = £21 15s. ÷ 407 = 12·82d. per ton.

Saving effected = 8·60d. per ton.

Results Obtained by Using the "D.B." Charging Machine and Pusher instead of Hand Drawing.

Coal carbonized. As before, 407 tons per week.

Wages paid.

4 stokers at 5s. per shift. . . =	£1	0	0 per diem.
2 coalmen at 5s. per shift . . =	10	0	,, ,,
2 machine men at 4s. per shift =	8	0	,, ,,
	£1	18	0

£1 18s. × 7½ days = £14 5s. per week.

Cost per ton = £14 5s. ÷ 407 = 8·4d. per ton.

Hence, the saving effected with machine charging and discharging, as compared with hand charging and drawing, on six beds of eights, 21 in. × 15 in. ⏛ retorts 18 feet through, is 13d. per ton of coal carbonized. These figures include coal out of stores to coke wheeled out to bank, but not furnace men, attention to hydraulic mains, or stopped ascension pipes, &c. Hence to obtain the total cost usually included in carbonizing, these items must be added to each set of figures—viz.:—

Firemen attending to furnaces, clinkering, wheeling out slag, &c.	2·5d. per ton.
Running off and filling up hydraulic mains, cleaning stopped pipes, &c.	1·5 ,,
	4·0d.

The cost of carbonizing, therefore, with "D.B." machine drawing and charging is 12·4d. per ton of coal, and includes getting the coal from stores and wheeling out the coke. It is proposed to add later a coke-handling plant, which will, it is estimated, further reduce the cost of carbonizing by 2·2d. per ton, bringing the cost to 10·2d. per ton of coal, and the saving would be greater if more beds were at work.

In the author's opinion, there is a very important factor, often ignored when figures are quoted showing the saving effected by the introduction of labour-saving appliances, and that is the initial cost of the installation, upon which 5 per cent. should be charged for interest on capital expended and 5 per cent. for repairs, and 5 per cent. for depreciation and renewals. The cost of the "D.B." stoking machinery installed at the Cavendish Street works, inclusive of coal-handling plant, power plant, charging and discharging machines, foundations, &c., is £1500, which at 15 per cent. equals £225. The coal carbonized at these works in twelve months is 16,000 tons. Therefore £225 ÷ 16,000 = 3·4d. per ton, the cost for interest, wear, tear, and depreciation.

The author now gives the complete cost of carbonizing per ton with "D.B." stoking machinery (without the coke-handling plant) on the quantity of 16,000 tons over twelve months; thus allowing for a less number of beds working during the summer months.

	Price per Ton of Coal.
Interest on cost of plant £1500 at 5 per cent. Depreciation and renewals 10 per cent.	3·40d.
Carbonizing wages	8·40
Retort-house wages incidental to carbonizing	4·00
Oil, waste, water, and sundry stores.	0·25
Gas used by engine (27 cubic feet per ton at 1s. 6d. per 1000 feet)	0·48
Total cost for carbonizing per ton	16·53d.

In works where the annual make is about, or less than, 200 million cubic feet per annum, the author considers that large overhead storage-hoppers may be dispensed with, and the initial cost of the installation thereby considerably reduced. In any case the coal must be elevated; and the only purpose served by large overhead storage bunkers is

that the coal may be broken and elevated during the day shift, and any breakdown of the elevator or conveyor attended to without interfering with carbonizing. But these safeguards may sometimes be too dearly purchased in the matter of capital outlay. In the case of works of about the size named, there is little or no saving to be effected by large storage hoppers in addition to the overhead measuring-chambers; but in works of larger size, no doubt the extra capital outlay is compensated for by reduced working expenses and other advantages gained. The pusher for discharging the retorts has only been very recently introduced; and the author prefers to have several months' constant work with this machine before expressing a definite opinion. So far it has proved quite satisfactory; the coke is discharged with ease and certainty, and the power required to work the machine is only some 3-horse power.

From the interest shown of late in new contrivances and developments of various forms of stoking machinery, many of which are departures from existing practice, it is evident that much attention is now being given to the subject, and there will probably before long be a large increase in the use of machinery for charging and discharging gas-retorts, along with the necessary and most important adjuncts of coal and coke handling plants. More especially is this likely to be the case in the more moderate sized works, where so far machinery has not been adopted to any large extent in the retort-house and adjoining coal and coke stores. The arduous and exhausting work of hand stoking is likely soon to be, therefore, to a very large extent a thing of the past. In these days of competition—which may become more keen in the future—it behoves all to modernize and get their works equipped as far as possible with the latest and most up-to-date appliances for the manufacture of gas, so that gas may still hold its own as the best, cheapest, and most popular illuminant; and with gas at half the present prices, there is an enormous field for its use for heating and power purposes.

In conclusion, the author desires to acknowledge the progressive policy of, and express his indebtedness to, the Chairman and Directors of the Derby Gas Company in giving every encouragement and affording facilities for the introduction of plant which had to be taken as more or less of an experimental character. So far, the results have abundantly justified their forward policy.

Discussion.

The PRESIDENT said he was sorry that Mr. Lewis, of Wellingborough, was not present; but perhaps Mr. West could give some particulars of the installation there.

Mr. J. WEST (Manchester) said he felt a delicacy in discussing the paper, because the inventors of the apparatus described were not allowed, by the rules of the Institution, to be there to draw swords with him; and he had therefore made up his mind not to say anything on the subject, because certain members thought he was somewhat privileged in being among them. Perhaps he was so, in a sense, because while he was a gas engineer he was also a manufacturer, and he therefore intended to leave it to those who used the apparatus. At the same time, perhaps he knew as much about what could be done and had been done as anyone. He regretted very much that Mr. Lewis was not present; but he believed most of them had some information about the installation started at Wellingborough. They were new works, and he conceived the idea of combining a drawing and charging machine in one, so that one man could perform the two operations instead of two men with separate machines. The chief feature about this new machine was that it put in all the coal at one stroke, and on its reverse action deposited the coal and righted itself automatically as it came out of the retort. The coal was put in in a perfectly even layer from end to end. He could not give the results of the working in make per ton, and so on; but he believed the returns were excellent. The retort-house was erected for fourteen beds of single retorts, seven settings of eight each. Two men did the whole of the work in drawing and charging, full particulars of which had recently been given in the "JOURNAL OF GAS LIGHTING."* The whole cost of working this plant, including the coal-elevators and coke-conveyors, everything being fitted up on the most modern lines, from taking the coal out of the waggons to the elevating machinery and conveying it into the large hopper—which held about 60 tons (sufficient for a night's supply), so that it saved the necessity of having men there at night to deal with the coal, there being only two men to attend to the drawing and charging and one to the furnaces and coke-conveyors—down to delivering the coke into waggons on the siding, was 6½d. per ton. It was really a re-arrangement of the original hand-charging machine, which went twice into the retort, charging the first half first and then the second half; and it ran in on wheels. He believed it was the most perfect charging-machine, as far as carbonizing coal was concerned, ever devised; and he conceived that if he could improve upon that, and put the coal in at once, he should be doing a good thing. He therefore doubled the length of the machine, and associated it with a central bar. There were two scoops, which directed the coal well to the sides of the retort, giving a perfectly level layer; and instead of going in twice, and running on wheels, he arranged it to be thrust in once, deposit its coal, and come back at one stroke. He should be delighted for anyone to see the machine in operation, as this would be far better for them than any description he could give; and he was quite sure Mr. Lewis would be pleased to show it. Mr. West added, in answer to the President, that the machine required the coal to be broken, as nearly all of them did. He believed there was a great advantage in breaking it up fresh; and, in fact, it was always found, when retorts were charged by machinery, that one got more per ton than by hand, if the work were properly done. He should not advocate a system of breaking up the coal and putting it into a store. He believed there were six beds now in operation. It was a moderate-sized works, and it would not have paid to put in a large machine. The hand machine was used before, and the only question was whether there would be any saving by putting in the power machines. This had been proved to be the case.

Mr. ISAAC CARR (Widnes) said the subject of the paper was the De Brouwer projector, but they had had a kind of supplemental paper on the Wellingborough installation. He thought it was only fair to confine themselves to discussing the very excellent contribution of Mr. Bell, the subject-matter of which was original to most of them; and he felt the greatest possible interest in the description of the way in which the apparatus was manipulated. So far as he could gather, the author had made it quite clear that there was no difficulty whatever in regulating the charges in regard to level and thickness to suit the varying conditions of the retort, because they all knew from experience that it was impossible to keep all the retorts, even in one setting, to a uniform temperature; and it occurred to him that if there were no means of regulating the various rates of charge to different retorts, there might be some difficulty. As he understood, by means of the measuring chamber and the speed of the wheel, they could regulate this to the greatest nicety. If this were all that the author had found the charging-machine to be, and the discharger ultimately proved equally successful, it would appear that the apparatus would represent a distinct step forward in the economical manufacture of gas. For many years they had had stoking machinery. It had been introduced into many works; and while it might have been morally justifiable, it could not be said in all cases to have been commercially so. In his own case, he had, at considerable expense to himself (because the works were comparatively small), refrained from the introduction of machine stoking, for the simple reason that he had not yet been able to see where any real economy would accrue. With regard to cost, the figure was given of 21·4d. per ton as the cost of hand stoking. But there was some difficulty in getting comparative figures; and he took it that this was not the whole expense per ton—that there were some additional costs outside the retort-house in dealing with the coal, firing the retorts, or handling the coke, so that the figure 1s. 9½d. would not represent the cost of hand stoking at Derby. He should like to know what it was in this particular case.

The PRESIDENT said Mr. Carr would find the amount in the paper, where 4d. extra was given.

Mr. CARR said that made the figure 2s. 1½d.; and he understood that the introduction of the machine represented a saving of something like 5½d. If the figure put down for interest and maintenance was sufficient, and this round saving of 6d. a ton was the result, he was satisfied that the machine must have a great future before it.

Mr. A. WILSON (Glasgow) said they were all indebted

* See Vol LXXXV., p. 527.

to Mr. Bell, not only for introducing another machine for doing the heavy, laborious work of the retort-house, but also for the clear and lucid way in which he had explained its working and the results obtained. He (Mr. Wilson) had had considerable experience with machine stoking; it being more than thirty years since he assisted in constructing the machine put into the Nine Elms Gas-Works for Mr. Robert Morton. After he came to London, he had a good deal of work with the American [Ross] machines; but they turned out unsatisfactory in the end. After he went to Glasgow, he assisted his late illustrious chief, Mr. Foulis, in the work of bringing out the Arrol-Foulis stoking-machine. All these systems had their advantages and disadvantages; and no doubt this one of De Brouwer was the same. The Ross machines were also coal-projectors—at least the charging-machine was; the coal being driven into the retorts by blasts of steam. On paper, the thing looked very well; but when it got into actual work there was a difficulty in securing certainty of charging—in putting the proper quantity of coal in the right place; and he was afraid that this machine would labour under the same disadvantage. He knew he was treading on dangerous ground, but it seemed to him that when the retorts were new, and everything was in apple-pie order, the inclined retort system, this system, or any other which relied on either the force of gravity or the force with which coal could be projected into a retort, might act very well, but would fail to a greater or less degree when the retorts became old and wrinkled, and had protuberances of carbon upon them. It was impossible for the man to judge accurately the quantity of coal which should be put into the various retorts. In this De Brouwer projector, the coal was certainly under great command; but they heard whispers that it was working under disadvantageous conditions, and that it was not a success everywhere. He did not want to say much about that; but he was told the previous day, by a gentleman of practical experience, that where the retorts were old they were not able to work the machine to advantage. This accorded with his experience of carbonizing work and machine stoking. A great many who started with the inclined retort system obtained splendid results when everything was new; but they had to confess to-day that there was another side to the shield, and that when things were not in so good a condition they did not get the same results. Mr. Bell had been working the De Brouwer projector with retorts perfectly new, when everything was smooth, and it was like shelling peas; but he (Mr. Wilson) had not a doubt that by-and-bye Mr. Bell would begin to find his difficulties commence. Those who had the Arrol-Foulis or West machine need not be alarmed that they would be superseded. With either of these machines there was a certainty of action. The coal was put in where it was wanted with certainty every time. If there were any golfers present, he thought he could explain what he meant. When they got on to the putting-green, a professional could afford to play up a good many times, and hole out his ball. He might do it very often; but he did not do it always. He failed occasionally, through want of skill, inequality of the ground, or some little obstruction. But any child could, at the first trial, pick up the ball, and put it into the hole every time. This was just what they did with the West or the Foulis machine. They picked up the coal, and placed it exactly where they wanted it every time; and he did not think this was possible in the other case. The same thing held good with regard to the discharger. Take the inclined retort system again. At the beginning there were not many difficulties in discharging the coke; but after a time they began to crop up, and it was found that a machine had to be put on to force the coke out. In the present case there would be the same thing, in a more aggravated form. If they had a long single layer of coke to be pushed out, it might go, and very likely it would go; but if the retorts became crooked, out of line, with little bits of carbon here and there, he foresaw that there would be difficulties with the discharger in the same way. Where they had to force the coke out from one end of the retort to the other, it would in many cases buckle up, and, instead of going out in a nice stream, would jam. With the ordinary drawing-machine, it took out a certain quantity of coke at the beginning, and then worked its way to the back and brought out the rest of the charge; so that there was a certainty of action. But in the present case he thought the uncertainty was obvious. The machine would not work the same for every kind of coal. With the coals they had in the North, he did not think it would work at all, because they did not have the caking coal they had in the South. The coke lay like so much sand or so many nuts; and when once they started to push it out, it got up in a heap. He wished Mr. Bell all success, and thought the machine he had adopted might meet a want in small works; but for large works he (Mr. Wilson) was still prepared to stand by the stoking machinery they had.

Mr. Tim Duxbury (Oldham) said there were one or two points on which he should like a little more definite information. One was as to the quality of the coal Mr. Bell used—whether nut coal, slack, or screened or broken coal—and whether he had had any experience with broken coal; the lump and small being charged at one time. He had seen a charger fill the retort with nuts and coal separately; but he had not seen it work with mixed coal. Did the large coal overrun the small, and leave it behind—the coal going forward and charging the retorts unevenly? With nuts or cobbles separately, he knew that the machine charged a new retort well; but he rather agreed with Mr. Wilson that when the retort became uneven there might be some difficulty. The chief point with him was the discharging operation; and he was sorry Mr. Bell had not had sufficient experience of this to give them more definite information. Discharging was of great importance, because, under all conditions, if they happened to be short of gas, and wanted to go in for five or four hour charges and get the heat down, he felt that they would have some difficulty in ramming or pushing out the coke. From his experience of inclined retorts, he thought this would be the difficulty—that the coke in the retorts would jam instead of being pushed out. At present he was advertising for tenders for systems of retorts—inclined or horizontal—with some kind of power machine, or with the De Brouwer or any other projector. It was more particularly about the discharging that he was anxious; and if Mr. Bell could give any more definite information on this point, it would be a favour.

Mr. T. Canning (Newport) said Mr. Bell had given the members a paper of first-class importance; and he must congratulate him upon it. At the same time he should like to ask a few questions about the working of the machine described. In the first place, he was concerned to know if, when in operation, the slightest excess of speed would not cause a massing of the coal and a heaping of it up at the farther end of the retort. For example, he said there was a starting resistance fitted with a magnetic overload release attached to the back of the motor-box, and a rheostat for varying the speed of the motor. Now, this rheostat was, he understood, in charge of a working man. It was a very delicate instrument to regulate the speed; and all was to be done in 20 seconds, or in 25 seconds at the outside. He did not think the British working man changed his mind in 25 seconds.

The President remarked that he should not like to say that. (Laughter).

Mr. Canning said he would bow to the superior knowledge of the President on the point. There was always a certain amount of friction in coal, and in the discharge from the hopper there must be some. If the hopper discharged slowly, and the President's view were correct, and the workman did change his mind and turned on the high speed a little sharply to overcome the friction of the coal, what would be the result? In order to counteract the friction of the coal in motion, a slight extra speed would be required. With regard to the operation of charging, Mr. Bell said the motor was to a certain extent automatically regulated, because the position of the dial to which the handle was pointed was indicated by a mark, and was such as to give a speed suitable for the average charge or size of coal used, which for broken coal was about 120 revolutions. Now, as Mr. Bell used a coal-breaker, he (Mr. Canning) wished to know how it came to pass that there was this variation. He thought there was a necessity for control by a dial; and he could quite understand that the dial was required. The danger he was looking to especially was that of uneven charging. In the course of his paper, Mr. Bell said the principal use of the groove was to keep the coal from flying about before it came to rest on the band; and the operation of bringing the coal to the required velocity was not centrifugal. This was a very ambiguous sentence; it covered a great deal and hid something. It was perfectly true that, if one read it as it stood, the bringing of the coal to the required velocity was not centrifugal, because the

belt was going at the same speed as the coal; but if Mr. Bell meant to imply that the working of the machine was not by the use of centrifugal force, it was wrong. The discharge was tangential; but he need not dilate upon that. They were told that the coal tended to continue in its straight-line motion, when it left the belt; it therefore continued in tangential motion. But the motor surely was centrifugal; and therefore the action of the machine was centrifugal—that was to say, for the discharge into the retort, but not for the velocity. To sum up, supposing the speed of the discharge were out of proportion in any degree whatever—and, as Mr. Bell had said, this was left absolutely to the judgment of the man in charge of the machine—should the proportion of that force be in any way out of the ordinary ratio with the resistance that had to be encountered in the retort, there must necessarily be an improper charge. He was somewhat dubious about any change being made in the speed within 20 seconds. He took it, of course, that the electric motor was a continuous current one; and Mr. Bell had not told them how he expected this light motor to be influenced by the position in which it was placed. In conclusion, he should like to say that he attached great importance to the paper, which must interest them all, especially those who were considering the introduction of machinery on a larger scale, knowing full well that it was absolutely necessary at the present day to be thoroughly awake. He had only asked for information, and pointed out difficulties which might or might not exist; and he hoped experience later on would show that they did not.

Mr. J. W. Helps (Croydon) said Mr. Canning had, to some extent, forestalled him on one point on which he thought a little further information was required—namely, with regard to the necessity of altering the speed during the process of charging. He had had an opportunity of seeing the machine at work at Bruges and at Bâle; and he also saw a somewhat similar one in operation in Paris. One thing that struck him as being in favour of the De Brouwer charger was that he was told it required practically no alteration of speed during the process of charging. In the Paris machine, certain mechanism of a somewhat complicated nature was introduced, which allowed of an alteration of speed being made throughout the charge, to suit the position in which the coal had to be placed. The complication was not inconsiderable; and it struck him as being a point in favour of the De Brouwer machine that no such alteration of speed was necessary. From what they had been told by Mr. Bell, however, it seemed that alteration was required; and, as they had heard from Mr. Canning, it did not eliminate the personal equation, and left to the man the manipulation of the machine, which both at Bruges and at Bâle he was told was absolutely unnecessary. He would also like to ask Mr. Bell what prompted him to put the charger and discharger on different sides of the retort-house. It was quite apparent that there must be some objection to having the charging and discharging going on on one side, as the machine might be in the way. But it struck him, on looking into the matter, that considerable advantage would accrue if both machines could be on one side, and the coke could be pushed out on the opposite side, where one conveyor for coke would be practically necessary, and they could take all the smoke, steam, and dust away from the working parts of the machine. It had been said that the success of this machine must, to a great extent, depend upon the success of the discharger. Now, at Bruges and Bâle the charging-machine alone was at work—the discharging being carried out by means of an ordinary rake; and when one read, as one did in this paper, that a saving of 4d. a ton was effected when the discharger and charger were used, as compared with when a hand charging-machine was employed, it was very evident that, from the money point of view, the success of the system did depend on good discharging being brought about. Whether this conjunction and the De Brouwer discharger would stand the test of time, and would work as well with old retorts as with new ones, remained to be proved. He only hoped it would. He would, however, point out another matter which appealed to him somewhat, and that was the great suitability of this machine for alterations rather than extensions. When an engineer had to consider the carrying out of certain work which did not necessitate building a new retort-house, and had to adapt new machinery to existing conditions, he naturally had to go very carefully into the consideration of this De Brouwer machine. If one had a house, as in this case, less than 50 feet wide, it was apparent that, without considerable structural alterations, it would be impossible to put in the excellent machine of Mr. West or the Arrol-Foulis machine. But it was not necessary with such an appliance as this, that the setting should be in the middle of the house. It could be put on one side, and plenty of room could be got for charging and discharging on the same side. This was a point that would appeal to many. He had in his own works excellent stoking machinery, with which he obtained results approaching very nearly those given in the paper. But his works were much larger. He had now other retort-houses to fit up which were not wide enough to allow of the West machinery to be worked with convenience; and therefore he was forced to consider such a machine as the De Brouwer.

Mr. G. Helps (Nuneaton) said he could hardly add much to the discussion, because the machine they had in use at Nuneaton had only been there for ten days. He had read the paper with some care, and generally he was in agreement with the whole of it. He had seen Mr. Bell's installation at Derby, and considered there was only one better arrangement in the country, and that was the one at Nuneaton. Mr. Bell said he preferred the machine running on rails; while he (Mr. Helps) thought the floor arrangement was better. The figures Mr. Bell gave of working cost, judging by the short time he had had the machine at work, were, he should say, practically correct. They reckoned at Nuneaton to save with a charging-machine 1s. a ton; and, so far as they had gone, he thought it was certain to do this. It was very easy to criticize a machine of this kind by comparing it with other stoking machinery; but it would be very difficult for any man to conceive a more simple machine than this. He believed they were mostly agreed on one point—namely, that no carbonizing result could possibly be better than that obtained by shovel charging; and this machine appealed to him as being a substitute for, or as superseding, shovel charging. The speed of the belt could be regulated to practically anything desired; and this enabled one to use lumps, beans, nuts, or dust. It had been said that this machine was not likely to be a success everywhere. He would ask: What was? A great many were in disagreement with regard to what was and what was not good carbonizing. Some were satisfied with 10,000 cubic feet of gas per ton, while others wanted 12,000 feet. Mr. Allan, of Scarborough, to whom he owed very much, had shown him how to make 12,000 cubic feet of gas per ton; and this was worth something. It had been said that this machine worked perfectly well with new retorts, but that when the retorts had lumpy bottoms—a kind of switchback—it did not. Again he would say: What would? If any gentlemen present were working with retorts in such a condition, they ought to take them out. He had seen retorts which had been in use six, seven, and eight years, and the floor was as good, for all practical carbonizing purposes, as a billiard-table. Mr. Morland, of Gloucester, could bear him out, and so could Mr. Paterson, of Cheltenham; and he would suggest that anyone who thought he was "speaking without his hat" should go down to Gloucester or Cheltenham and see there what he saw. He had never seen retorts in such a condition after the number of days for which they had been at work.

Mr. S. Y. Shoubridge (Sydenham) said he had had the advantage of seeing the De Brouwer projector at Derby, and was very much impressed by the beautiful simplicity of the machine, the great ease with which it was manipulated, and the excellence of the work it was doing. He saw a little machine there, similar to the one described, consisting practically of four pulleys, two struts, and a dynamo, charging retorts as quickly and as well as could be done by two of the ponderous machines of the older type. This seemed to him an enormous advance on anything yet done, because it meant a great saving in capital expenditure. These small machines when put up did not cost more than one quarter as much as the larger machines of the older type; while the saving in maintenance and in working was very material. Another great advantage seemed to be that it was applicable to retort-houses of all sizes, almost the smallest, and equally good for the very largest. As the author rightly pointed out, the principle of the charging-machine was not centrifugal—it was due to the impetus given to the coal by the velocity of the belt; and it would be quite possible to effect the charging without the large wheel. He was not

THOMAS GLOVER & CO., LIMITED,

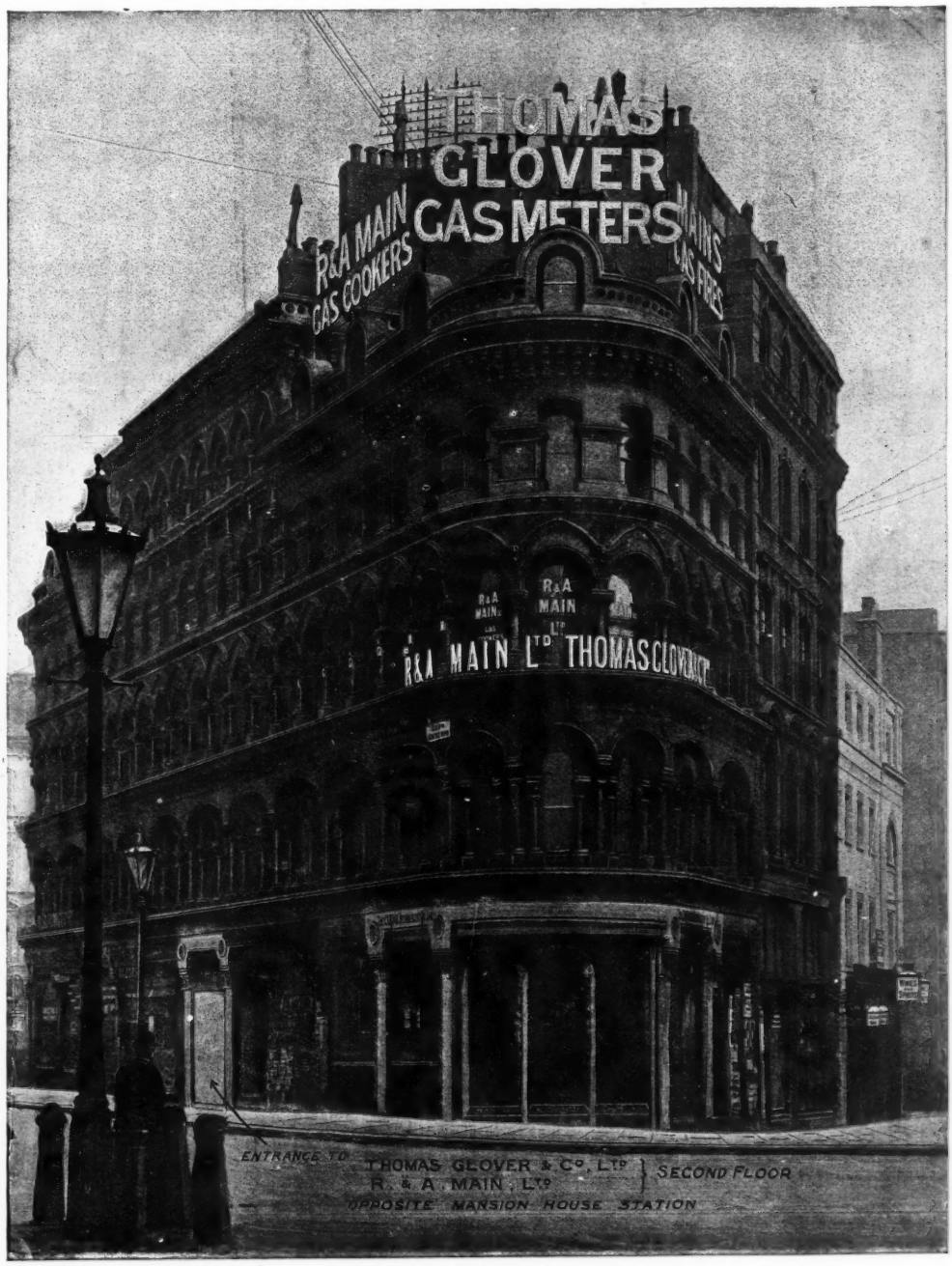
GAS-METER MANUFACTURERS,

AND

R. & A. MAIN, LIMITED,

GAS-STOVE MANUFACTURERS.

NEW CITY OFFICES.



LATE OF CLERKENWELL, NOW 49, QUEEN VICTORIA STREET.

Telegraphic Address: "GOTHIC, LONDON." **Telephone No. 6159 Bank.**

BRISTOL:	BIRMINGHAM:	MANCHESTER:	GLASGOW:	BELFAST:	MELBOURNE:
28, BATH STREET.	57 & 58, BROAD STREET.	132 & 134, CORN EXCHANGE BUILDINGS.	26, WEST NILE STREET.	8, EXCHANGE PLACE, DONEGALL STREET.	23, WRIGHT'S LANE, LONSDALE STREET
Telegraphic Address: "GOTHIC."	*Telegraphic Address:* "GOTHIC"	*Telegraphic Address:* "GOTHIC."	*Telegraphic Address:* "GASMAIN."	*Telegraphic Address:* "GOTHIC."	
Telephone No. 1005.		Telephone No. 3898.	Telephone No. 6107 Royal.		Telephone No. 3715

THE WELSBACH KERN SELF-INTENSIFYING SYSTEM.

No. 604.

No. 35a

The name **Welsbach** is our guarantee of quality, and a protection against disappointing results.

35a **SHADOWLESS LANTERN** (**500** in use in **NEWCASTLE-ON-TYNE**)
604 **SUSPENSION S.I. LAMP** (Interior Lighting). **Enamelled throughout—No Paint used.**

Both Lamps are produced in three sizes, giving about

150 Candle Power for 5 feet of Gas per hour.
300 „ „ „ 10 „ „ „ „
600 „ „ „ 20 „ „ „ „

Write for Catalogue of New Patterns.

THE WELSBACH INCANDESCENT GAS-LIGHT CO., LTD.

14, PALMER STREET, WESTMINSTER, S.W.

Telegrams: "Welsbach, London." **Telephone: 290 Westminster.**

at all sure that they would not soon see a machine in which this was accomplished. The only difficulty was to keep the coal on the strap until it attained the same velocity as the strap; but the large pulley was a very simple and beautiful arrangement for effecting this, and he doubted whether it could be improved upon. He had not had the good fortune to see the discharging-machine, as it was not at work at the time of his visit; but he hoped it would prove as successful as the charger. Even if it did not, and if it were an entire failure, it would not affect the great advantages of the projector, because ordinary drawing-machines could be used in conjunction with it—in fact, for very small works he thought it would be better to adhere to the old-fashioned hand drawing, simply using the projector. The saving the author had effected, of 13d. per ton, compared with his already low cost of 2s. 1d. for hand-charging, was something on which he was to be highly congratulated.

The PRESIDENT said they had had a very interesting discussion, but he thought he saw his way to add to it. They must have been very much struck by the remarks of Mr. Helps, of Croydon, who said that one advantage of this machine was that it could be put into an old house. The new school would sweep away the old house entirely; forgetting all about the capital account, they would clear the old house away, and go ahead. One thing dwelt upon by Mr. Canning in regard to the machine was that it had to work with such extreme nicety. He (the President) had failed to discover any machine on earth that was as good as a man; and even he sometimes, when he was a little tired, or had regaled himself on a Saturday night, was not always so accurate a machine as they would like. In all these processes, whatever they were, there were these little hitches which were incidental to every kind of operation, whether purely manual or mechanical. But they tended to level down; and he did not think there would be the amount of difficulty Mr. Canning apprehended. If they had watched the machine at Nuneaton, charging ten or twelve retorts in a few minutes, they would be satisfied as to the general success of the apparatus; and as to the adjustment of the rheostat, fortunately a man could change his mind in a few seconds. This was the reason why there was no process of gas making in the world which produced such good action on the retorts, and such good coke, as manual stoking. Next to this he thought would be Mr. West's manual machine, which he had described; and the farther they got away from this, the worse the results would be likely to be. They had learnt a new thing lately about inclined retorts—and he knew something about this. It was said that if they only took coal and mixed it up with some of the breeze, they were going to do a great thing—to burn the breeze into good coke; and they need not worry about it. The coal put into the retort, whether small, granular, or large lumps, tended to coalesce, and to be carbonized altogether in one continuous process. But the breeze put in had been coked perhaps the day or a month before; and this was not in a condition to coalesce and be absorbed and amalgamated. It was true that when it was pulled out it all came out apparently in a mass; but if it were looked at with a microscope or carefully with the eye, it would be found that the foreign material had disintegrated it, and if the coke were carried far, or handled, not only would the original breeze be found, but some more besides. What was the breeze put in for? He saw a few days previously some very nice sloping retorts—a nice brown colour, new, in the best condition. He went to the top of the retort, and there it was the same colour as when it came from the maker—a nice yellow, not suggestive of any great amount of heat. A little lower down it was black; farther on it was a dull red; lower still a brighter red; and at the bottom white hot. He asked the unfortunate gentleman who had to carbonize (and there were retorts there which cost £300 apiece) why he took it over from the contractor, because the retorts were heating very badly. He said he did it on purpose— that he was obliged to keep the bottom 6 feet of the retort very hot, but the top had to be kept cooler because there was no coal there, it was all at the bottom. This was grand carbonizing; and when he saw the coal come out at the other end, all very well burnt, but not much of it for a retort 18 feet long, he learnt something about this mixing of breeze. He then asked if they had found any difficulty with slipping charges; and the answer was: "Yes, at first." But it occurred to the manager to mix a little breeze with the coal, and this made it less slippery, and it worked better. So the breeze was going in, 6 feet of the retort was doing all the work, and the rest very little. This was the result with the breeze, which they had been lately told was going to improve their coke returns. He had great faith in what Mr. West had told them about the success of the manual machine, which helped the man but did not entirely replace him. A man could direct and control that machine, and perhaps this was better than one in which the whole thing was done automatically. He might say that very near that building—at Wandsworth—some very economical carbonizing work was being done. The gas was very cheap—2s. and a few pence per 1000 cubic feet—and therefore it could not be manufactured extravagantly. There the work was done by two little coffee-pot engines, one drawing and one charging the retorts; and the coal was always put in with two scoops, the weight being taken at the same time by the machine, and the charge was turned over on each side into an even layer. He would challenge anyone present to find anywhere else retorts which were only charged four times in 24 hours producing 8000 cubic feet per mouthpiece; and this was what they did—16,000 cubic feet of gas per day out of one retort, the retorts being 20 in. by 15 in. ⏛. These machines were put in by a gentleman who never advertised himself—Mr. Freeman. He worked the whole thing out some twenty years ago, and it went on very comfortably, and the whole cost was about £350. The machine ran along the floor of the retort-house. There was no overhead coal-store, no smashing the coal up, for he thought in London the coal came too small already, being sometimes not much better than dust. There was no coal-breaking, no elevating, no engine, no rheostat, no electric arrangement, or anything else. The work was, as he said, all done by two little coffee-pot engines. Mr. Freeman never patented it, and nobody cared about it except the Chairman of the Company, who was very glad to see the economy effected, and that he had not spent his capital in the heroic fashion which he was afraid would apply to his friend Mr. Duxbury, who appeared to be going to advertise for three different sorts of plant. He should very much like to see his specifications and drawings, because it appeared to him that going to work like that, with three competitive systems, he would naturally be very much in the hands of the contractors; he (the President) could only pray he might be delivered from them. The upshot of all this was that he had sent both his sons to look at the machines at Derby and Nuneaton, and he thought they would see some of these very machines shortly at work; for if there was anything that would beat the Wandsworth machine it was this one.

Mr. ISAAC CARR said there was one question he had forgotten to put. It was obvious to all that a serious accumulation of carbon in the retorts would be fatal to the apparatus; but it had been suggested to him on the previous day that each time a retort was charged an air-blast passed through, the effect of which was to prevent the accumulation of carbon that took place under ordinary working conditions. He should be glad to know if this were so.

The PRESIDENT said he really thought they were bound to keep the retorts clear. At any rate, they were not going to reject this machine because someone allowed his retorts to carbon up.

Mr. BELL, in reply, said he was glad to see Mr. West present, and must congratulate him and the Engineer of the Wellingborough Gas Company on the results which they were getting. There was no doubt that, with West's machines well handled, good results could be obtained; but he thought there was room enough for the West, the Arrol-Foulis, and the De Brouwer machines in different works. With regard to Mr. Carr's last question, the speed at which the coal went into the retort when charging carried a certain amount of air with it, and this kept the retorts free from carbon. The retorts at the Cavendish Street works had been in use for eight months, and were never scurfed nor had a bar put into them. In the four bull's-eyes there was a small amount of carbon, strange to say, on the bottom corners, where probably the air had not reached to burn it off. With regard to the kinds of coal used, they had fine slack, small nuts, large nuts, and broken coal; and up to now he had found no difficulty. In fact, as far as he knew, the charging-machine was capable of dealing with various classes and grades of coal. Mr. Canning had been rather sceptical about the difficulties and the complications of the machine; but the one real merit of the charger—and he thought the same applied to the discharger—was its great

simplicity. With regard to altering the speed for discharging, before they started to move the coke they required a certain amount of power; but as the coke began to slide along, they could reduce the power or increase the speed. What they had on the machine was a controller very similar to that in use on the tramways. The operator turned a wheel one way or the other, and so increased or reduced the speed of the motor. Mr. Helps asked why he had put the charging-machine on one side and the discharger on the other. It was simply because the retort-house was about eighty years old, and was only 46 feet wide; and there was not sufficient room to put two machines on one side of the house. This led to the question raised by the President, as to making the best use of the plant one had. He (Mr. Bell) was a great believer in trying to keep down capital outlay; and, instead of sweeping away old buildings, utilizing them to the best advantage. It spoke something for this machine that they could put it into a retort-house built eighty years ago and only 46 feet wide. Mr. Shoubridge had answered one or two questions raised by Mr. Canning. With reference to the cost of charging retorts, Mr. Wilson mentioned that in one case he had heard remarks that the machine had not been a success. He believed this was so; but he was informed that the retorts were in a very bad condition. He was sorry Mr. Simmonds, of Bury, was not present, or he could have told the members that he had had the machine in use for six months, working most of the time with fine slack, and he informed him in a letter that he was quite satisfied, and that the total cost of carbonizing was only 13d. per ton.

MEMBERSHIP ADDITIONS AND TRANSFERENCES.

MEMBERS.

Archer, A. W., Enfield.
Brown, J. H., Nottingham.
Burch, A. R., Uxbridge.
Casterton, George R., Melton Mowbray.
Chaney, W., Birmingham.
Cotton, F., Dublin.
Davies, Guy S., Pontymister.
Duesbury, H. D., Hertford.
Fergusson, William, Barrow-in-Furness.
Hawksley, C., Westminster.
Kent, F., Worksop.
Lamb, J. E., Altrincham.
Lowe, J., Glasgow.
Walker, Alex. B., Walker-on-Tyne.
Young, A. C., Arbroath.

ASSOCIATE MEMBERS.

Godwin, T. S., Watford.
Goodenough, F. W., London.
Holroyd, Robert E., Yarmouth (I.W.).
Moon, J. C., Nottingham.
Nuttall, L. W., Keighley.
Smith, J. F., Halifax.
Smith, M. G. C., Newcastle (N.S.W.).
Smith, S. T., Walsall.
Thompson, A. M., Singapore.
Whimster, John W., Lower Sydenham, S.E.

ASSOCIATE.

Stoddard, Reginald H., Works Manager of the Halifax Corporation's Tar Distillery.

TRANSFERENCES.

The following have been transferred from the class of associate members to that of members:—

Akam, H., Bradford.
Lang, J., Fraserburgh.
Quicke, W. J., Perth (W.A.).
Smith, A., Glasgow.

During the visit to Arundel on Friday, the members corrected an oversight in the transaction of this part of the business by electing as an Honorary Member the President of the Société Technique du Gaz en France.

BRITISH ASSOCIATION OF WATER-WORKS ENGINEERS.

Annual Meeting at Hull.

The Ninth Annual Meeting of this Association was held on Thursday, Friday, and Saturday, last week, in the Council Chamber of the Hull Town Hall, which had been placed at the disposal of the Association by the Corporation. At the commencement of the proceedings, Mr. R. H. SWINDLEHURST, the retiring President, occupied the chair. The Mayor of Hull (Alderman Jarman, J.P.), accompanied by the Sheriff (Mr. J. H. Fisher, J.P.), and supported by several members of the Corporation, were present to welcome the members to the city.

The MAYOR, who was cordially received, said it afforded him much pleasure to give the Association a very hearty welcome to Hull. He sincerely trusted that their gathering would not only be of advantage and profit to themselves, but that the interchange of views on the various subjects discussed would also redound to the advantage of the communities which they in no mean measure served. He congratulated the Association on having chosen the Water and Gas Engineer of the city (Mr. F. J. Bancroft, B.Sc., Assoc.M.Inst.C.E.) to be their President for the ensuing year. He considered that they had honoured themselves in honouring Mr. Bancroft, whom they in Hull held in very high esteem. He could promise them an interesting and enjoyable time during their visit. At any rate, it would afford them an opportunity of seeing something in the way of water-works which they might go home and try to equal. (Laughter and applause.)

The SHERIFF joined in the welcome. He said he was quite sure that when the members went to see the Hull Water-Works they would be very pleased, as he was a few days previously, when he turned on one of the valves of a new reservoir. Hull, unlike many big towns which had to go considerable distances for their water, had within a few miles of the city a bountiful supply, of a very high degree of purity, by reason of which the city was in a very healthy condition.

The CHAIRMAN expressed his appreciation of the cordial welcome given by the Mayor and Sheriff, and, on behalf of the Association, conveyed to them the very hearty thanks of the members for their kindness.

The business was opened by the reading by the SECRETARY (Mr. Percy Griffith) of the minutes of the eighth annual meeting, which were duly confirmed.

THE NEW PRESIDENT.

The CHAIRMAN then introduced his successor in the presidency; remarking that it was quite unnecessary for him to say anything in doing so, as Mr. Bancroft was so well known to all of them.

THE LATE PRESIDENT.

Mr. BANCROFT, in taking the chair, said he had to thank Mr. Swindlehurst for his kind reference, and also the Association for the cordial way in which they had endorsed it. It was his pleasurable duty to ask the members to give a hearty vote of thanks to Mr. Swindlehurst for the efficient way in which he had presided over the deliberations of the Association during his year of office. The preparations he had made at Bolton were fresh in their memory; and he was sure Mr. Swindlehurst would look back with pleasure on his occupancy of the presidential chair.

Mr. SWINDLEHURST, in acknowledging the compliment, said he took up the duty with many misgivings. Thanks, however, to the sympathy and forbearance of the Council, he had been able to discharge it. He wished to thank the Secretary for his cordial and helpful support.

THE PRESIDENTIAL ADDRESS.

The PRESIDENT then delivered his Inaugural Address, the principal portions of which are given in the following abstract. He began by thanking the members for the honour which they had conferred upon him by electing him their President, and then passed on to notice the satisfactory growth of the Association during the past year—the addition of twelve members and two associates bringing the number up to 300. He said he estimated that the members were responsible for the management of water-works of a total capital cost of £56,000,000, serving a population of 14 millions with a daily supply of 444 million gallons of water. Having referred to the two successful meetings held last year, he pointed out that though the Association was only eight years old, the number of the members and the increasing interest attached to their gatherings showed conclusively the advantages which had accrued from its formation. In view of the more general recognition of the need of an ample supply of pure water to a district, in order to ensure the health, happiness, progress, and prosperity of the inhabitants, he laid stress upon the desirability of those who have charge of works furnishing this necessary of life holding periodical meetings, and by reading papers, exchanging ideas, and having social intercourse, adding to each other's knowledge for the benefit of the undertakings entrusted to their charge. These general remarks led up to a reference to the decision the Special Committee of the Association had come to in the matter of the standardization of cast-iron pipes, which they thought could be better entrusted to the Engineering Standards Committee than to themselves. On the subject of the codification of water-works regulations, the standardization of consumers' fittings, and the registration of plumbers, the President reminded the members that a Joint Committee had been formed to deal with it, and upon it the Association were very liberally represented. He added that Sub-Committees had been appointed to take up the three broad divisions of the main subject, and that considerable progress had been made in preparing the ground for further investigation. A few observations on the financial condition of the Association brought the introductory remarks to a close.

The President then turned to technical matters, and dealt first with the consumption of water per head. He remarked that, whether it is for purposes of investigation into a new or additional water supply or for inquiry into the adequacy of an existing one, the question always presents itself to the water engineer of what is or will be the consumption per head. If the district is a rural

one likely to rapidly become urban, provision must be made for the change in its character, as well as for the increase in the population. Mr. Bancroft is no believer in the small consumptions occasionally brought to our notice from towns and districts where the supplies are restricted at the recurrence of every dry season, and where the consumers have a continual dread of being without a full supply. The measure of the adequacy of a public water supply is, he says, the ability to furnish the maximum hour's demand in the day of greatest consumption. If the maximum demand is unprovided for, a restricted supply has to be furnished at every recurrence of warm, dry weather—the very time when an abundant use of water is most essential for the health and convenience of the consumers. Consequently, it is of paramount importance to recognize that a water undertaking should be fully capable of supplying the maximum hour's draught in the maximum day's consumption. If there is a service reservoir of sufficient capacity, the maximum hour's demand is eliminated so far as the machinery and the source of supply are concerned, and the maximum supply required on any one day is the important factor. The President illustrated this by his own case at Hull. The Royal Commission on the Metropolitan Water Supply in 1892 adopted 35 gallons as a safe basis of calculation for the future daily requirements per head of the population of Greater London. The maximum day's consumption being about 20 per cent. in excess of the average, Mr. Bancroft is of opinion that in large towns a capacity to furnish a maximum supply of 50 gallons per head per day will probably be the standard in the near future; while in small towns and rural districts an average of about 30 gallons, with a maximum of 36 gallons, per head per day should be sought.

These being the quantities of water which may be required in the future, the President proceeded to consider the subject of the water-bearing capacity of the chalk. His experience as a water-works engineer has been chiefly in water supplies derived from this source, which is one of the most important in England. It extends over 12,879 square miles (of which 8759 square miles are outcrop), and varies in thickness from (say) 300 to upwards of 1500 feet. The exposed area receives an average of from 24 to 35 inches of rain per annum. When the chalk has an underlying impervious bed, it forms a natural impounding reservoir for the storage of water. The extent of the outcrop is a measure of the proportion of the rainfall which will sink underground, subject, of course, to the influence of overlying beds which may have the effect of passing rainfall into another underground watershed. The quantity of rain which soaks into the chalk will vary with the amount and character of the rainfall (whether heavy or slight), the season of the year in which the fall takes place, and the nature of the surface of the ground (whether compact or loose, steep or flat, bare or cultivated). At Lea Bridge, the quantity percolating in three consecutive dry years was found, with artificially filled gauges, to be as low as 3·63 inches per annum. The President thought this matter of sufficient importance to collect the estimates and observations with reference to percolation in the chalk which were presented in evidence to the Royal Commission already referred to; and these he gave in his address. They show that geologists and meteorologists estimate that with a mean annual rainfall of about 27 inches, the mean annual percolation of water into the chalk is from 7 to 10 inches, and in three consecutive dry years from 3½ to 4 inches per annum. After carefully weighing the whole of the evidence, the Royal Commission adopted 3·37 inches of percolation as the quantity which might fairly be relied upon as obtainable by pumping, and which could be abstracted on the average of three dry years, without prejudicially interfering with the surface and underground water supplies higher up the valley. The President pointed out that in estimating the probable quantity of water available for water supply, the years of minimum percolation must be taken as the basis of any safe calculation.

Some particulars were then furnished by the President of some percolation experiments carried out in connection with the chalk area in Yorkshire. They showed that a cubic foot of chalk will absorb about 2 gallons of water. In a square mile of saturated chalk 100 feet thick, there is consequently 5575 million gallons of water. This, however, is not available for water supply. The water in the chalk may be classed under three headings: (1) Water of capillarity; (2) water in the interstices; and (3) water flowing through the interstices. The water in the second class may be drawn upon for a time; but it will not afford a permanent supply. The only water really available is that which passes through the chalk. If it is not utilized, it flows away into the rivers and the sea.

After being satisfied as to the probability of obtaining an ample supply of water from a given area, the next point for the consideration of the water engineer is the site of his well. This was the matter which next occupied the President's attention. He said the position of the well should, if possible, be where there is an impervious stratum of moderate thickness over the water-bearing rock. This will ensure all adjacent surface pollutions being shut off, as the water will have to travel some distance from the outcrop to the well, and efficient filtration is likely to be ensured. On the other hand, a heavy cap of tertiaries over the chalk is to be avoided, as the latter will probably be very compact, and will not yield water except in small quantity and very slowly. A site near the escarpment should be avoided, and the surface level should be as low as possible, so that as large an area of the chalk as possible may be drawn upon, and capital cost saved. Other considerations, such as nearness to railway stations and length of pumping main, are secondary. Both of the pumping-stations of the Hull Corporation fulfil the essential conditions of being on low ground and having a protecting layer of clay over the chalk. At the Cottingham pumping-station, the chalk is overlaid with rubble chalk, clay flints, and chalk flints, forming underground storage for the water, and along which it flows, comparatively speaking, freely. Upon Mr. Bancroft's recommendation, the Corporation in 1901 obtained an Act empowering them to purchase a protective area of 80 acres around the wells, and also to make bye-laws for securing the purity of the water; these laws to be in force within a radius of half a mile from the pumping-station.

Of course, well water is liable to pollution, and therefore the President very properly alluded to the subject. He showed that, according to the evidence of Dr. M. A. Adams in the Maidstone inquiry, the subsoil, in its effect upon the water passing through it, may be classified as follows: (1) Top layer or danger zone containing putrifying organisms; (2) intermediate layer or risky zone containing nitrifying organisms; and (3) safe zone. Water to which matter from the first zone has gained access, or which has only passed through the first zone—*i.e.*, surface water—must be considered dangerous. The second zone will yield a less dangerous, but not a safe supply. The deep-seated water is quite safe. It is common knowledge that the level of the underground water rises and falls; and when the soil overlying the water-bearing stratum is clay, a prolonged drought may easily produce dangerous conditions by causing the clay to lose cohesion and to become deeply fissured, and through these fissures foul matter from the surface may be washed down into the water-bearing stratum without undergoing any process of natural purification. A study of the reports on the typhoid epidemics at Maidstone, King's Lynn, Worthing, and Beverley shows conclusively that relations between water supplies and the surface of gardens or fields manured with human excreta, and the proximity of leaky sewers or accumulations of filth, are extremely dangerous; so that while deep-seated supplies are in no danger of pollution at the general gathering-ground, there is potential and imminent danger from contiguous collections of filth. Mr. Bancroft explained that he had ventured to deal at some length with this subject with a view to inducing those members who had well supplies under their charge to examine their pumping-stations and the adjacent areas, and satisfy themselves as to the purity of the surroundings, as he was confident this was a point which deserved the most careful attention of all water-works engineers dealing with underground water.

The next subject considered was the different kinds of pumping-engines. These may be divided into two distinct types. In comparing installations of pumping machinery of equal excellence in design and manufacture, Mr. Bancroft does not think there would be much difference in cost between a geared and a direct-coupled engine, if the cost of the pumps is included in each case, nor in practice is there any material difference in the cost of the foundations. Geared machinery must be provided with self-contained fixings, or bed-plates, and substantial foundations, or increased liability to vibration, noise, and breakdown will be incurred. With respect to mechanical efficiency, this depends on the size of the plant, the height of the lift, and whether the machinery is vertical or horizontal. Generally, vertical plant will give from 3 to 5 per cent. better efficiency than horizontal. The President has had experience in the working and management of both types of pumping plant; and though there are occasions when geared machinery may be adopted with advantage, for large installations he is decidedly in favour of that which is direct acting.

Coming to service reservoirs, the President explained that their function in connection with a pumping system is to maintain the supply to the town when for any reason it is necessary or desirable to stop pumping; and also to enable the engine and pumps to be run at their most economical speed. He finds that in Hull a storage capacity of 25 per cent. of the maximum day's supply would be sufficient to equalize the consumption and the discharge from the pumps when working at a regular speed for 16 hours per day. The points he wished to emphasize were that, though a service reservoir is not *absolutely necessary* in a pumping system, it is desirable to have one to secure the best and most economical working of the plant; and the size of the reservoir should be made the subject of investigation in each case. Where the supply depends on one pumping-station and a long length of pumping main, and all the water is pumped to the service reservoir, capacity for one or more days would appear advisable. Where, however, the supply is obtained from several wells, engines, and pumps, with "stand-by" machinery, and the pumping main is open to the distributing system, a much smaller capacity—say, from one-half to a day's maximum consumption—will suffice. Mr. Bancroft has known cases where, if the money laid out in large surface reservoirs had been spent in obtaining and utilizing additional sources of supply, the undertakings would not have been found wanting in time of drought. He is confident that if the foregoing considerations are borne in mind, they will be the means of saving unnecessary capital expenditure and releasing large sums for more profitable work.

As so large a proportion of the capital of a water undertaking is

spent in mains, the President said he should not apologize for bringing forward the subject of their position. Main thoroughfares in all the large cities and towns are now, or are likely to be, occupied by tramways, and the carriage-ways from kerb to kerb paved. He advocates the removal of all mains from under tramlines; trunk mains being laid at the side of the carriage-way in a position where they will not interfere with the drain-pipes leading to the sewer, and the footways being used for the service-mains, one of which should be laid on either side of the road. By entirely excluding small mains and service-pipes from the carriage-way, the liability to fracture by heavy traffic is removed, the length of the consumers' pipes is reduced to a minimum, and small repairs and connections can be made without the costly operations of breaking up and replacing the paved carriage-way. As in cities and urban districts the subsoil of the carriage-ways and footways is now crowded with pipes, cables, and conduits belonging to various companies having statutory or other powers with regard to them, the President said he thought each undertaking should have a definite position assigned to it in which to lay its conduits. The position adopted in Hull for laying service water-mains is in the footway, at a distance of 18 to 24 inches from the kerb; and this rule is recognized as far as possible by the other authorities having power to break up the streets.

The address concluded with the following remarks on the urgency of new water legislation:—

I should like to ask, first, What is the most pressing need of water undertakings, the urgency of which is felt by all concerned in the management of water-works, whether owned by corporations or companies? It is that we should have a department of the Local Government Board solely devoted to water supply, so that this subject and the many interests it involves may receive the attention which their importance deserves—nay, demands. Let us consider for a moment the most important aspects of this question. The total area of England and Wales is about 37 million acres, and the population about 32½ millions, or, on an average, less than one person per acre. An inch of rain per annum on an acre of land, if stored, will yield an average of 62 gallons per day, so that the collection of the equivalent of an inch of rainfall over the entire area of England and Wales would be sufficient to afford a water supply to about double the present population. There are in England and Wales alone some 2½ million acres of uninhabited moorland and mountain, forming admirable gathering-grounds, and having the highest rainfall of any part of the country. Evidently there is ample surface and underground water for all our present and reasonable future demands, if only it were protected from pollution, properly stored, justly allocated, and waste prevented. With reference to pollution, the present system of control over undertakings for public water supplies is unsatisfactory and entirely inadequate. Every public water supply should be subject to an annual Government inspection, so that at least imminent danger of pollution might be detected, and steps taken to remove the evil before any mischief resulted. At present, filth may be deposited on water-works land, sewers may be laid near wells, and sewage actually be poured into an absorbent water-bearing stratum without hindrance. We know in recent years the disastrous and fatal results that followed the pollution of the public supplies at Beverley, Worthing, Maidstone, and King's Lynn. In my opinion, such outbreaks would be entirely prevented if public supplies were periodically inspected by an independent authority; and the very existence of such an examination would make the authorities responsible for the local supplies more careful and alert.

The areas over which local authorities and companies have control are now settled by purely parochial considerations, and have no regard to superficial or underground sources of supply. Thus we have some authorities possessed of powers giving them the exclusive right to the water from a watershed yielding a supply largely in excess of their present or any probable future requirements; while, on the other hand, we have large rural areas without any proper water supply on the boundaries of cities where an abundant supply exists. Such areas are a menace to the health of the cities they surround. Owing to the multiplicity of authorities and the difficulty of obtaining combined action, many such areas which might be effectively supplied by a joint comprehensive scheme remain dependent for water upon shallow polluted wells. It should be the duty of the paramount authority to compel, if need be, the formation of Joint Water Boards, to deal with groups of towns and villages which, owing to position and surroundings, can only be effectively dealt with by a joint scheme.

Again, with regard to underground water, much of the present rivalry and uncertainty would be obviated if there were an authority entrusted with the general welfare of the water supply of the country, taking wide views, and having and exercising power in these matters. Still further, there is the want of uniformity in the powers of water authorities, both in regard to the sources and supply of water and the regulation of its use by consumers. The following General Acts all include references to matters connected with water supply: The Public Health Act, 1875 (itself superseding four earlier Acts); the Water-Works Clauses Act, 1847; the Water-Works Clauses Act, 1863; the Gas and Water Works Facilities Act, 1870; the Gas and Water Works Facilities Act, 1870, Amendment Act, 1873; the Limited Owners, &c., Facilities Act, 1877; the Public Health (Water) Act, 1878; the Water Companies (Regulation of Powers) Act, 1887; the Companies Acts, as incorporated in Private Water Acts; and the Local Government act, of 1894. There has been no general legislation relating to water supply since 1847, all the subsequent Acts being in the nature of amendment and supplement; and the need for revision to meet present requirements is shown, if in no other way, by the fact that in all recent Acts certain standard clauses have been regularly accepted, and are incorporated in the Model Bill issued by the Private Bill Office of the House of Commons. Surely the time is now ripe for a consolidation of all these enactments into a new General Water Act.

Further, I would call attention to the necessity for greater uniformity in our bye-laws and regulations for preventing waste and misuse of water, and the desirability of all undertakings being called upon to supply annual returns as to levels of water, storage capacity, quantity supplied, &c., similar to those which the owners of gas undertakings are required to give to the Board of Trade. These matters have already been brought before the President of the Local Government Board by a deputation from the County Councils Association, the Sanitary Institute, the Underground Water Preservation Association, and our own Association; and the fact that bodies with such divergent interests have been brought together for the purposes of concerted action, alone shows the pressing need of new legislation dealing comprehensively with the water supply of the country.

At the close of the address,

Mr. W. MATTHEWS (Southampton) proposed a vote of thanks to Mr. Bancroft for his admirable address, which he said embodied the fruits of very valuable experience.

Mr. H. ASHTON HILL (Birmingham) seconded the proposition; and it was carried by acclamation.

NEW MEMBERS AND ASSOCIATES.

The Scrutineers reported that the ballot had resulted in the election of the whole of the gentlemen nominated as members and associates. The list is as follows:—

Members.—Acton, E. V., of Trinidad (B.W.I.); Gray, Bruce M'Gregor, of Selby; Lawrence, A. J., of Pontycymmer; Madeley, J. W., of Hayfield, Derbyshire; Smith, T. R., of Kettering; Smith, A., of Dartmouth; Stevenson, W. E., of Leeds; and Surtees, R. T., of Newton-le-Willows.

Associates.—Bellamy, Noel F. A., of Plymouth; and Wibberley, J., of Guildford.

PAPERS AND DISCUSSIONS.

The reading and discussion of the papers in the following list was then proceeded with:—

"The Working Costs of Water-Works Pumping-Engines." By Messrs. MEYSEY THOMPSON and HUGH LUPTON.

"Puddle and Concrete for Reservoir Embankments." By Mr. W. WATTS.

"The Administration and Control of the Nation's Water Supply." By Mr. R. E. MIDDLETON, M.Inst.C.E.

"The Definition of Pure and Wholesome Water." By Dr. J. C. THRESH, Medical Officer of Health for Essex.

"Air-Lift Pumping Plant at the Birkenhead Corporation Water-Works." By Mr. J. W. M. RICHARDSON.

"The Geology of South-East Yorkshire." By Professor PERCY F. KENDALL.

"The Treatment of Moorland Water." By Mr. C. CLEMESHA SMITH and Dr. E. M. CHAPLIN.

A paper describing the Appleton extensions of the Warrington Corporation Water-Works, by Mr. G. Mitchell, on the *agenda*, was not read; and some of those given in the above list had to be curtailed owing to want of time. Abstracts of the papers and discussions will appear in succeeding issues of the "JOURNAL."

SOCIAL EVENTS.

On Thursday, the members were entertained at luncheon by the Mayor; and there were present, in addition to the Alderman and Councillors of the city, many well-known public men engaged in the shipping commerce of the city. His Worship was supported on his right hand by the President of the Association, and on his left by the Sheriff and Alderman Massey, the Chairman of the Water-Works Committee of the Corporation. Some toasts were honoured, including that of "The President." In the evening, the President entertained the members at a smoking concert at the Grosvenor Hotel. On Friday evening, he presided at the annual dinner of the Association, which was held in the hotel. The toast of "The Association" was proposed by Alderman Lerard, and responded to by Mr. Bancroft. Mr. R. Watts (Sheffield) proposed "The Mayor and Corporation," which was acknowledged by the Mayor and his predecessor in office (Alderman Sir Alfred Gelder). The Sheriff proposed "Kindred Societies." Mr. Blackburn (Sunderland) gave "The Council and Officers," and Mr. H. Ashton Hill "The Visitors."

An instructive feature of the meeting was a visit to the Springhead and Cottingham pumping-stations of the Corporation; while the docks, the cement-works of Messrs. Earle, and other objects of interest in the town, attracted many of the members. On Saturday afternoon, a large party left Hull for Belgium, where the present week will be spent in inspecting the Antwerp, Brussels, and other water-works, and in visiting some of the attractive spots in the country.

THE GAS AND WATER STOCK MARKET.

(For Stock and Share List, see p. 794.)

LAST week was a disappointing one on the Stock Exchange; for although there was nothing very important in the form of sport to distract from the pleasures of business, yet things were decidedly quiet in the markets. In fact, some of them were absolutely stagnant. However, the tone did not suffer much, for a good steady tendency ruled firmly, and some of the choicer sort actually made some advance. The settlement was the chief item of the week; and it appeared to be a moderate one. In the Money Market, there was a respectable demand for the usual requirements, and fairly good rates ruled up to the close; but discount terms eased away considerably. Business in the Gas Market was rather more active on the whole than the week before, though on one or two days it was very restricted indeed. There was an upward tendency still evident, notwithstanding that one or two of the leading issues which had recently been advancing freely now suffered a set-back. A noticeable feature was the improving attitude of debenture stock issues, a class which have for some time past been rather weighed down by adverse influences. Aided by the assured prospect of cheap money, these securities now look like resuming their normal position. In Gaslight and Coke issues the ordinary opened weaker, but was quiet. The next day it was offered rather freely, and continued to give way; and on Friday it was at its lowest, changing hands once at 91⅛. However, from this point it rallied a little, and marked 92⅜ before the close. The secured issues were little dealt in. The maximum was erroneously put up and lowered again next day; but the debenture had a firm advance. South Metropolitan was fairly active, but a little uncertain. On Tuesday, it was done at 128; on Friday, at 125½; and on Saturday, it ranged from that price to 127. But the debenture was strong at a good advance. Commercials were very quiet; and there seemed to be no stock in the market. There was a little more life in the Suburban and Provincial group; and Crystal Palace debentures and Bromley issues had a rise. Southampton debenture and Plymouth cease to be quoted owing to continued absence of transactions. The Continental Companies were almost stagnant, but Union came out favourably on *ex div.* adjustment. Among the remoter undertakings, Oriental had an advance, but San Paulo receded. Business in the Water Companies was only very moderate; but several issues made further advances—New River being again conspicuous with a rise of 10. Grand Junction, having paid the dividend, was a shade easier.

The daily operations were: Monday was a very quiet day. Gaslight ordinary fell 1; but ditto debenture and Crystal Palace debenture rose 1. Tuesday was much more active. Gaslight ordinary fell 1. In Water, Kent gained 2; ditto new and West Middlesex, 3 each; and Lambeth 7½ per cent., 2. Wednesday was very quiet, and nothing moved in Gas, but New River rose 5. Thursday was active. South Metropolitan debenture was marked 1 higher. New River again advanced 5. Friday was a lively day. Oriental rose 3, Bromley 2, ditto new 1½, and Gaslight maximum and South Metropolitan debenture 1 each, but the ordinary of each fell 1. On Saturday, Gaslight maximum was put back 1.

SULPHATE OF AMMONIA AS MANURE.

A SECTION of the recently issued report of the Cornwall County Council, on the agricultural experiments carried on under their auspices, deals with the respective values of sulphate of ammonia and nitrate of soda as manure for potatoes. It is stated that, as in previous experiments, the appearance of the haulm and the weight of tubers pointed to the conclusion that, although the nitrogen of each of the manures is taken up as nitrates, each has its own particular effect upon the potato. The result of the various experimental growings is to show that the use of sulphate of ammonia gives distinctly superior results over nitrate of soda. Each plot of land experimented upon was manured with 4 cwt. of superphosphate and 4 cwt. of kainit per acre, in addition to the nitrogenous manures. The unmanured plots gave an average yield of 5 tons 14 cwt. 1 qr. 15 lbs. per acre, and the plots treated with the standard manure mentioned above 5 tons 16 cwt. 3 qrs. 7 lbs. per acre. Treated with 6 cwt. of nitrate of soda, the yield was 7 tons 17 cwt. 1 qr. 10 lbs. per acre; while with 5 cwt. of nitrate of soda per acre it was 8 tons 4 lbs., and with 4 cwt. per acre 7 tons 11 cwt. 1 qr. 8 lbs. The fact that the yield was not increased by the more liberal use of nitrate of soda is noticeable. In the case of sulphate of ammonia, the results obtained were, from the use of 3 cwt. per acre, an average crop of 8 tons 15 lbs., and from 4 cwt. per acre 8 tons 6 cwt. 3 qrs. 16 lbs. The Committee confess that it is difficult to understand why the use of one form of nitrogenous manure should give better results than another; but they suggest as an explanation that the action of sulphate of ammonia is slower than that of nitrate of soda, and that consequently the effects on the crops is extended over a longer period. As a contribution to the discussion of the respective values of sulphate of ammonia and nitrate of soda, attention is called to Professor Warrington's paper in the "Journal of the Royal Agricultural Society," Vol. XI., third series.

ELECTRIC LIGHTING MEMORANDA.

Bristol Electricity Supply Finances—Application of the Bolton Rule of Solvency—The Effect of such Application—The Maximum Supply System for Power Connections at Dundee.

THE finances of the Bristol electricity supply undertaking were recently discussed by the Town Council on the presentation by Alderman Pearson of the annual accounts of the Committee. He began by explaining that the Committee reserved a free hand to alter prices and conditions to suit the needs of customers. It is to be hoped the Bristol Gas Company will take note of this frank declaration, and do likewise. What is sauce for the Corporation goose, must be sauce for the Company's gander. Thus, by way of illustrating the point, Alderman Pearson stated that the ordinary charge for electricity for lighting is 5d. per unit, subject to discounts of from 5 to 30 per cent. The effect of this heavy discount is shown in the average price obtained for current sold to private consumers, which is 3·23d. per unit. The public lighting is charged 2·86d. per unit, which is fair in the circumstances. But when it comes to striking the balance on the accounts, Alderman Pearson, as an apostle of municipal trading for profit, makes some curious admissions. The capital outlay on the undertaking amounts to £542,000—not a great sum for the place; and for the past year a gross profit of £31,530 was realized. The Alderman was careful to point out that in the case of a company this would have been called profit out of which interest and dividends would be paid. This is not quite accurate, because, in the case of a company, the interest on the borrowed money would be set aside before the amount of the true profit available for the dividend was ascertained; but let that pass. The remarkable thing is that Alderman Pearson prefers to put it that the Electricity Committee of the Bristol Corporation have to pay £13,967 for interest and £9356 to the sinking fund, and be content with calling the balance of £8207 "profit." He then proceeds to call the sinking fund depreciation, and also takes credit for a reserve fund of £7000.

In dealing with the Bolton electricity accounts, in which the sinking fund is regarded as a part of depreciation, we applauded this way of treating the subject. It is obvious, however, that to treat a sinking fund as an element of depreciation is a very different thing from representing it as the whole of this charge on electricity supply capital. We recorded, moreover, that if the Bolton standard for this combined provision is taken as correct, it means that the absolutely necessary amount of appropriation out of revenue to capital account is thrice the mere interest. Applying this rule to Bristol, it appears that the amount of the provision should be £14,000 × 3 = £42,000 in round figures. Actually, there is only £31,531 available for the purpose, which means that the Bristol undertaking lacks over £10,000 a year to make it as solvent as that of Bolton. One or the other must be in the right. We are not singular in thinking that this is not Bristol. Alderman Godwin seems by the newspaper report to be uneasily suspicious that the rosy picture of the state of the electricity supply finance of the city painted by his municipalist colleague is rather over-coloured. This means of correcting it should, therefore, prove useful in the circumstances.

The last time we discussed Bristol electric supply finance in these columns, it was contended that the undertaking was going to the bad, at the rate of about £10,000 a year. There is no sort of satisfaction obtainable from the corroboration of this dictum which the example of Bolton furnishes. Alderman Pearson talks about his profit balance of £8207; but, unfortunately, the balance is on the other side by the greater amount stated. They know something in Bristol about the risks and unforeseen expenses of keeping up a supply of electricity; for there has already been one fire of considerable gravity at the works. What, in the circumstances, is the amount of comfort to be derived from the assurance that there is a reserve fund of £7000 for this costly undertaking? It is high time the Bristol Corporation took independent auditors' advice on the finances. Here is a concern ten years old, which ought already to have been depreciated by £40,000 besides the amount paid off the loans. Instead, the capital is to be increased by £126,000. In the circumstances, the amount appropriated from the balance on revenue account for capital charges is very inadequate. If this means that the Corporation do not charge enough for current, the matter should be gone into, for—not to put too fine a point upon it—the electricity undertaking is at present insolvent, and every year will see it approaching nearer the eventual demonstration of this fact.

A rather humorous state of things has come to pass in Dundee, where the people have given up as a bad job the maximum demand system of charging for electricity, apparently for the sufficient reason that they cannot understand it. If there is anything a true Scotsman is captious about, it is the correctness of any bill he may be required to pay; and it is one of the salient peculiarities of the maximum demand system that nobody can possibly tell in advance what the amount of the account will be. In view of the circumstances, it was extremely bold of the Dundee Electrical Engineer to suggest an extension of the maximum demand system to the power branch of the Corporation electricity supply. The Engineer was of opinion that the flat rate of 2d. per unit was not fair to all power consumers; and he accordingly proposed that the charge should be made by a modified application of the maximum demand system, under which the rated power of the

motors installed should be taken as the consumers' maximum demand. This suggestion is an eminently fair one, if the system is to be esteemed as meritorious on any conditions. Indeed, it is clear that the system is as badly needed for users of electric power as of the light, if not more so. Unfortunately for the professional adviser of the Corporation in this matter, it happened that one of the most occasional users of Corporation electric power was a newspaper printer in the town; and what is the use of having a local organ of public opinion, if one is not to profit by it? This newspaper printer has a couple of large motors which take current from the street mains only when it suits the proprietor to do so, which is when his own private supply breaks down, or proves insufficient. Obviously, no maximum demand system that could be devised would please this particular customer; and being a manufacturer of public opinion—well, it is unnecessary to pursue the explanation. The Corporation Electrical Engineer must make the best of the flat-rate system. When one comes to think of it, however, this extension of the maximum demand system to the supply of electricity for power would be just. An electrical journal, sympathizing with the Dundee Engineer, suggests that "probably his best plan will be to reduce the charge for power still further, and so, by securing a larger paying motor load, to make the inevitable loss on the few unprofitable consumers a relatively negligible though actually greater quantity." This is a dark saying, meaning, apparently, that when money is lost on all the power customers, the circumstances of some being more unprofitable than others will be less worth noticing. Anyhow, it shows what mysteries surround the subject.

A NEW EDITION OF "RYDE ON RATING."

THE first edition of "Ryde on Rating," though only published in August, 1900, has been out of print for some time. A fresh edition was therefore required; for the question of rating is one of those every-day problems than can never be described as lying on the shelf.* In the meantime, however, though the ordinary practice of rating has remained without substantial change, the law has tended to become unsettled, especially as regards the rating of machinery. Consequently, Mr. Ryde has been constrained to re-write a great part of the chapter (the 25th), which deals with machinery and fixtures. As he remarks in his preface, the interpretation put by the King's Bench Division in the case of *Crockett and Jones v. The Northampton Union*, upon the decision of the Court of Appeal in *Tyne Boiler-Works Company v. Longbenton*, has made the duty of Quarter Sessions in this regard extremely difficult. As recently as the 31st of March last, the Recorder of Leeds in *Kirby v. Hunslet Union*, gave a decision adverse to owners of machinery; while a fortnight later the Recorder of Hull, in *Eastern Morning News v. Hull Guardians* gave one the other way. Though so recent, these two cases are included by Mr. Ryde. There are 200 other new cases to be referred to. There does not appear to be any change in the treatment of gas-works rating, the leading cases being of old standing. The question of the rating of machinery, however, comes into the valuation very potently; and so does the new fashion of prepayment meter supplies, as affecting the amount of necessary tenant's capital. As regards the former order of considerations, attention is drawn to the difficult questions which occasionally arise as to machines which are partly of the character of fixed cranes, and partly like locomotive engines, in that they run on rails, though for a very short distance.

In the chapter mentioned above, the author points out that, in dealing with gas-works, the rateable value of which is calculated from the profits the hypothetical tenant could make, additional importance attaches to the question of the rateability of machinery, because, if machinery is no part of the rateable hereditament, the hypothetical tenant must be supposed to provide it out of his own pocket, and a deduction must be made from the profits of the undertaking by way of allowance for interest on the tenant's capital. So that the value of the necessary machinery (if not part of the rateable hereditament) not only ceases to be an addition to, but constitutes a deduction from, the value which the property would otherwise possess. Great significance attaches, in regard to all questions of ownership of machinery, to the Tyne Boiler-Works case, which rules the point of what machines are fixtures. The fact of physical attachment of the machine to the freehold was dealt with in this decision, which was, not that things not attached to the freehold can be rated, but that they must be taken into account in estimating the value of the rateable hereditament itself. Unfortunately, the sense in which machinery, while not rateable in itself, is to be taken into account as enhancing the value of the rateable hereditament, remains open to be decided whenever the judgment has to be applied in practice. This difficulty cropped up in the case of *Crockett and Jones v. The Northampton Union*, already mentioned. The decision in this case was that the question of any enhancement is one of fact for Quarter Sessions. If the answer is in the affirmative, the Recorder must assess the enhanced value as best he can, but not necessarily by way of percentage on the value of the machinery, and adding this to the annual value of the buildings apart from the machinery. It is not to be wondered at that in several instances Quarter Sessions, professing to follow this same rule, have arrived at very different results. The author himself is of opinion that the rule in the Tyne Boiler-Works case amounts practically to very little.

Questions of what are or are not fixtures present endless complication. Gas-engines held under a time-purchase agreement pass under mortgages. The mere existence of a time-purchase agreement in such cases does not affect the state of the law. It is the patent degree of annexation which all can see that determines the legal relation, not the circumstances of a chance agreement. This is the reason for the condition always attached in Gas Acts to any clause reserving the property in hired-out fittings, that there shall be a label on the chattel stating the fact of ownership. It is as well for the fact to be generally understood, that if gas-fittings and pipes inside dwelling-houses are so put in as to be easily detachable without injury to the structure, there is reason to hold that they do not pass with the freehold. There is no known case in point; but the inference appears to follow logically from the rule in *Holland v. Hodgson*, which is that the intention of the annexation must be looked at by the light of the degree and object thereof. It is, of course, a difficult question; but if the whole set and apparatus of a prepayment meter fit-up is removable, it seems to be reasonable that it might be removed. This is, however, not a question of rating; for, though a house is conceivable as being raised in value by the fact of containing gas-pipes, &c., it is never more highly rated on this account. It is rather unfortunate, for the author and publishers of this important volume, that the whole system of assessment should be in course of revision at the present time; for if the Valuation Bill passes, a large part of the book must become obsolete at a blow.

* "The Law and Practice of Rating, both Within and Without the Metropolis." Second Edition. By Walter C. Ryde, Barrister-at-Law. London: Butterworth and Co. and Shaw and Sons; 1904.

PERSONAL.

Mr. H. P. MAYBURY, whose resignation of his appointment at Malvern to take up the position of Surveyor to the Kent County Council was recently notified in the "JOURNAL," was last Saturday week the recipient of handsome presents from the employees of the Malvern Urban District Council. The Clerk (Mr. H. L. Whatley), on behalf of the Surveyor's and Clerk's Department, first of all presented him with a handsome silver rose-bowl, suitably inscribed, and an illuminated address, as a mark of goodwill and esteem, and an expression of the regret felt at his relinquishing his position, and wishing Mrs. Maybury and the children a continuance of their prosperous career and all happiness and health. On behalf of the workmen, Mr. W. Lambert (a former clerk) afterwards presented Mr. Maybury with a fitted dressing-case and Mrs. Maybury with a lady's dressing-case. In doing so, he expressed the hope that Mr. Maybury would attain to further heights in the profession, and wished the family long life and happiness. Mr. Maybury, who was received with enthusiasm, said the ten years which he had spent in Malvern had been very happy ones. He alluded to the many important works which had been carried out—sewerage, gas, electricity, &c.—and remarked that, though they had cost a great deal of money, he was sure they were for the benefit of Malvern. The position of Surveyor was not altogether an enviable one, as it was necessary to please not only the Council, but the ratepayers as well. In the discharge of his various duties, it had always been his endeavour, while seeking to carry out the work efficiently, to study the interests of the ratepayers. In conclusion, Mr. Maybury paid a tribute to the workmen under him, and said that there had been the most intimate terms of friendship existing between them. His chief regret was leaving them; and although at times he had spoken harshly to them, he had always had their best interests at heart. Proposing the toast of the employees, Mr. Lambert remarked that if Mr. Maybury had spoken harshly to them he never allowed anyone else to do so. A pleasant evening was spent; and at the close Mr. Maybury bade each one farewell. On a subsequent occasion, Mr. Maybury was presented by Sir Henry Lambert, on behalf of the Council and inhabitants, with an address and some silver plate; Mrs. Maybury being the recipient of a piano.

THE ANALYTICAL VALUATION OF GAS COALS.

At the Meeting of the Institution of Mining Engineers held in London on the 2nd and 3rd inst., Dr. G. P. LISHMAN submitted a paper on the above subject, which, it may be remembered, he dealt with at a previous meeting, as noticed in the "JOURNAL" at the time.* By permission of the Council of the Institution, we are able to give the following abstract of the paper.

The manner in which various processes for valuing gas coals were tried, different forms of apparatus used, and the "standard coal" method adopted, was detailed in the author's previous paper. Having had a further two years' experience of the working of the process therein described, which confirmed his opinion of its value and necessity, he devoted the communication recently

* See Vol. LXXIX., p. 1492.

submitted to the Institution to a closer examination into certain details. In reviewing the history of this interesting subject, he showed that there had been very great variety of procedure, and also that considerable dissatisfaction had been expressed with regard to the methods of testing coal on a small scale. He referred to the work of Andrew Scott (1879), John M'Crae (1892), and the Research Committee of the North British Association of Gas Managers (1893), as recorded in our pages at the time; and cited the report of the Committee to the effect that "all analysis should be conducted on a thoroughly practical scale"—a conclusion which had been previously come to by the Association of German Gas-Works Chemists. The author went on to show that the continuous record of coal testing ever since the introduction of gas lighting indicates that there has always been a demand for information about gas coals at a less cost than a practical trial would entail. As early as 1819, Accum published lists of various coals and their yield of gas; and his apparatus, though crude, was useful in distinguishing cannel from bituminous coal. Clegg, in 1841, illustrated in his "Treatise" a new form; and some years later Mr. Sugg designed plant which served as a model for subsequent forms. Other workers in this field have been Mr. Lewis T. Wright, Mr. J. T. Sheard, Dr. Wallace, Mr. Leicester Greville, Mr. T. Glover, and Mr. Harrison Veevers, whose investigations have been fully described in the "JOURNAL."

After a short review of what has been done abroad on this question, the author pointed out that there is no generally agreed manner of testing gas coals. He showed in his previous paper that the results obtained with the various forms of laboratory plant come out most irregularly; and in his later one he gave a table of those obtained with the same coal, mostly on different days, during the first half of last year. The tests were all made from the coal used as a standard, the illuminating value per ton of which is 580 lbs. of sperm. The yield of gas varied from 9650 to 12,400 cubic feet per ton of coal; and the illuminating power, from 13 to 18·1 candles. The differences of sperm value extend through the whole range of quality of ordinary gas coals—that is, from 500 lbs. to 667 lbs. of sperm per ton. The figures show, however, that, even when working with water-jacketed condensers (which may be assumed to be very suitable for such a purpose as this), the direct testing of gas coals is useless for comparative purposes, and that any result may be obtained according to circumstances.

The conclusion arrived at by Dr. Lishman as the result of his latest investigations is that the idea so frequently found in the literature of the subject, that the laboratory apparatus gives results higher than those obtained in the gas-works, but comparable to each other, is not borne out. There are many apparent reasons why they should be higher, but they are all overborne by the differences of condensation which occur; the temperature of the apparatus being the main determining factor in the quality of the gas. When the retort is hottest, it may happen that the condensers are also hottest. Then a large yield of gas is obtained, and it is ill condensed, and consequently of higher illuminating power than it would otherwise have been. Hence a high sperm value is obtained. A new retort makes a difference. A cast-iron retort lasts about a month, towards the end of which time the yield of gas has begun to fall off, and after a week the change is sometimes noticeable. The state of the purifiers also affects the gas. In a continuous series of tests on a gas coal, no regularity in the results is to be expected from day to day. These details show how essential it is that there should be some check on the indications of an instrument like a coal-testing apparatus.

The author then proceeded to give some account of the manner in which the standard coal can be utilized in the valuation of others; his remarks being as follows: It may be said that all extreme results, whether in yield of gas or in sperm value, are rejected as standards of comparison with unknown coals. However many tests may have been made, the results in these cases are rejected, and the coal tested again on another day. All the results recorded in the table were obtained from the standard coal, but several were rejected as standards of comparison. Although the sperm values in the table are highly variable, they are in nearly every case explicable when one or more of the causes detailed above are taken into consideration, and very often each one was just what might have been expected at the time when it was obtained. Occasionally, unaccountable results will come out, but they are rare. If a series of tests be made from the same coal on any day, the results will, after the first two charges, generally be fairly constant, so long as the apparatus is not allowed to become warm and the retort temperature remains the same. This being so, the testing of an unknown coal is an easy matter. Three tests will probably suffice: (1) Unknown coal, (2) standard coal, and (3) unknown coal. The two from the unknown coal being near each other, the mean is taken, and the figure corrected proportionately, according as the standard coal is giving a result higher or lower than its fixed normal value.

Sometimes, however, the case is less simple. It has often been noticed in a series of tests made during one day, and using the same coal, that the sperm values continue to come out higher for each successive test. This is commonly due to the apparatus becoming gradually warmer; and it is hopeless then to operate without a standard. In such a case, at least five tests are required to fix the unknown coal; the second and fourth being made with the standard coal. If a series of sperm values such as (1) 530, (2) 548, (3) 570, (4) 585, and (5) 605, be obtained, being a rise of about 18 each time, it may be safely inferred that the same figures would have been obtained had the same coal been used in all the tests, and that therefore the unknown coal is equal to the standard. The standard coal has a fixed value (in the writer's case) of 580 lbs. per ton; therefore the unknown coal is reported as having this value, though, under the particular conditions of that day's testing, the average result was only 568 lbs. The same result (580 lbs. per ton) is obtained by taking the mean of tests (1) and (3), which makes the sperm value 550 lbs.—that is, on a par with the intervening test from the standard coal; so that the unknown coal would have to be corrected up to the normal value of the standard coal. But it is necessary to make the five tests, in order to be assured that the considerable difference between (1) and (3) is due to a uniform rise in the sperm value, and not to some other cause. When the results are rising in this manner, and the unknown coal differs considerably from the standard, the calculation of the former becomes more complicated, and frequently cannot be carried out; and then the coal must be retested at a more suitable time. Often, however, the quality can be gauged, as shown by the results contained in the following table, taken from the author's note-book:—

No of Test.	Sample of Coal.	Yield of Gas per Ton.	Illuminating Power.	Sperm Value.
		Cubic Feet.	Candles.	Pounds.
1	Unknown . . .	10,700	13·5	494
2	Standard (580 lbs.)	11,050	14·8	561
3	Unknown . . .	10,400	15·3	546
4	Standard . . .	10,700	16·4	601
5	Unknown . . .	10,700	16·4	601

In this case, the room was becoming warmer during the whole of the time occupied by the tests. There is a difference of 107 lbs. in the sperm value between the first test, taken from the unknown coal, and the last; and the third test occupies the intermediate position at 546 lbs.—there being a rise of about 25 lbs. in the sperm value for each test. In order, therefore, to bring all the results to an equal footing, 50 lbs. must be added to the first test, and subtracted from the fifth, and 25 lbs. added to the second and subtracted from the fourth. The following series is thus obtained:—

Test.	1.	2.	3.	4.	5.
Sperm value, unknown coal	544	—	546	—	551
Do. standard coal	—	586	—	576	—

The sperm value of the standard coal is here seen to be practically at its true fixed value of 580 lbs.; therefore the other coal requires no further correction, and may be taken as having a sperm value of 547 lbs., or 10,500 cubic feet of gas of 15·2-candle power.

The author concluded his paper with the following remarks: Sufficient has now been said to give an idea of the somewhat oblique paths by which it is necessary to proceed in order to arrive at the value of a gas coal. If ever it should be necessary to value gas coals as between buyer and seller, it seems to the writer that, in the present state of knowledge, the only method of avoiding contention would be to adopt a common standard coal obtained from a certain locality. The value of this standard once agreed upon, there would be no need for differences of more than about 15 lbs. in the sperm value obtained by different workers. In the case of a gas company who perhaps have no access to a seam of coal, the best way to obtain a standard coal would probably be to select a colliery, preferably one which supplies gas coal from only one or two seams, and take the finest hand-picked coal obtainable from the waggons from that colliery. To this coal a fixed sperm value of any reasonable figure could be arbitrarily given, and utilized as above described. This method would certainly not be so good as always drawing coal from a single definite seam, but as an alternative it would be found of value. With the increasing use of incandescent burners, illuminating power as ascertained in the ordinary way, by burning raw gas at an argand burner, is becoming of less moment; its place being gradually taken by calorific power. Whether, however, the quality of a coal be measured by its sperm value (a function of the yield of gas and the illuminating power) or by another figure (the product of the yield and the calorific power), it seems likely that a standard coal will be required in testing. Experiments to determine this point are being made by the writer.

Accompanying the paper was a valuable bibliography of the subject.

American Gas Engineers at the St. Louis Exhibition.—The twenty-seventh annual meeting of the Western Gas Association is being held to-day in the Gas Exhibit Department of the St. Louis Exhibition, which is under the control of the Association. Owing to the meeting being limited to one day, to allow of the members attending the Gas Congress to be held to-morrow and Thursday, there will be only two papers—one being by Mr. W. H. White, of New York, on "Low Candle Power Gas;" and the other by Mr. F. H. Shelton, of Philadelphia, on "Coal Projectors." The Western Association will contribute three papers to the Congress: "Gas Inspection," by Mr. Ira C. Copley; "Station Meters," by Mr. D. M'Donald; and "The Labour Question," by Mr. F. H. Shelton.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

The Conversion of Coke Dust and Breeze into Large Coke.

SIR,—Adverting to Mr. Herring's note in the current issue of the "JOURNAL," I should like to say that some ten or a dozen years ago I tried the experiment of mixing 5 per cent. of breeze with Durham coal in one retort-house at Vauxhall. The result was a failure; for I did not increase my yield of gas, but spoilt the coke, which was made so friable or "rotten" that it fell to pieces.

CHARLES CARPENTER.

South Metropolitan Gas Company,
June 13, 1904.

SIR,—Last year, this was tried at the Milan Gas-Works for fifteen days; but the experiment had to be given up owing to the spongy bad quality of the coke and the increased production of breeze.

All the water from the quenching of the coke in the hot coke-conveyors, was run into settling tanks, and the breeze taken therefrom was found to contain a large percentage of small coal, which fell over the stops in the inclined retort mouthpieces. The idea was to carbonize this, and so reduce the large production of breeze.

The experiment was made with 8 per cent., 5 per cent., and 3 per cent. of breeze, well mixed with the coal before being elevated into the coal-hoppers. On commencing with the 8 per cent. of breeze, the charges were much better burnt off, and there was a slight increase in the gas produced per ton of coal carbonized.

Some years ago, similar experiments were made with ordinary coke-breeze mixed with the coal in horizontal retorts; but this had also to be given up owing to the bad quality of the coke produced.

CHARLES BOURNE,
Ex-Chief Engineer of the Milan Gas-Works.

Ireshope Burn, June 9, 1904.

SIR,—I read with great interest the account, in last week's issue of the "JOURNAL," of the suggestion made by Mr. Herring of converting coke dust into large coke by mixing the former with the coal before charging into the retorts. This scheme is such a simple one, and yet likely to give such good results, that one fails to understand why it has not been thought of before.

The only objection that I can see is the extra wear and tear that will be put upon the mechanical transporting appliances. At present those in use for handling the coal work exceptionally well, with hardly any wear and tear; but if a large proportion—say, 15 per cent.—of breeze is to be passed through the elevators, it is almost certain that the repair account on these appliances will be considerably increased.

There is, of course, no difficulty whatever in putting feeders in to regulate to a nicety the proportion of breeze passed into the elevators. All engineers who have inspected the overhead coal-hoppers have noticed that, owing to the method of working, some of the small coal passes on to the end section of the hopper. Would not the breeze similarly be passed on? Further, admitting that coal and breeze as mixed could be delivered evenly all along the overhead coal-hoppers, is it not a fact that the coal (especially the large pieces) would first find its way into the measuring chamber, and the small coal and breeze would gradually accumulate in the angle of the hopper?

W. F. HOLLAND,
Smethwick, June 9, 1904. For the NEW CONVEYOR COMPANY.

[This subject was also commented upon by the President of the Institution of Gas Engineers at the meeting last week. ED. J.G.L.]

Looking Back.

SIR,—I think we must go further back than Mr. John Birch Paddon, if the President of the Institution of Gas Engineers wishes to confer the distinction of the introduction of the "rotary washer." It is quite clear, I think, from the first volume of "King's Treatise on Coal Gas" that Mr. John Reid was the first pioneer, followed by Mr. Thomas Whimster, to whom we must in all fairness give the credit of the initial rotary washer.

It must, however, be admitted that both Reid and Whimster only hinted at the possibilities of the rotary ammonia machine; and the credit of going several stages further must be given to Mr. J. B. Paddon, as he evidently saw that, in order to succeed in any measure in dealing with the ammoniacal gas, successive strengths of liquor must be provided for.

The writer recalls, with great pleasure, an interview he had with Mr. Paddon at the Portslade Gas-Works, about 27 years ago, with a view to ascertaining what had been accomplished with regard to the extraction of ammonia with the machines erected in accordance with patent No. 3395 of 1869. The work done was not regarded as satisfactory. How could it be? The two essentials were lacking. Firstly, the machines were not divided to give differing strengths of liquors; and, secondly, scarcely any surface was provided to reproduce the water and liquor for ammonia absorbtion.

But the process of evolution—I do not like the word, it smacks so much of the "origin of species"—goes on; and on page 364, Vol. I., of "King's Treatise," there is an illustration of the first rotary washer-scrubber sold by a Company with which I was so many years connected, to the Leeds Corporation, then under the engineership of Mr. Henry Woodall. It will be seen by the illustration that seven different strength liquors were provided for, and that a very large amount of surface was presented to the gas. Mr. Woodall was well satisfied with its performance; but it had to give way to "progressive development," and what was considered a more efficient and perfect machine was patented by Kirkham and Hulett and Messrs. Chandler in the year 1877—No. 4928. Since then it has again and again been improved by the last-named, right down to the isolated bearing of very recent introduction.

Notwithstanding that the process of development is still going on, and must be acknowledged, it would be idle to say that the makers of rotary washer-scrubbers have reached even yet the best and most perfect machine. I do not refer to the extraction of ammonia, which is practically down to ½ grain per 100 feet of gas, as we all know; but it may be that there is still something to be done which will reach a greater efficiency in strength and quantity of liqour, as well as finish and cost to the purchaser.

Still the difference between the John Reid and Paddon and the present-day rotary washer-scrubbers is no greater than we should expect through the progressive development of 37 years. All honour to the pioneers!

JOSIAH CHANDLER.

39, *Victoria Street, S.W., June* 10, 1904.

The Houghton-le-Spring Gas-Works in the Past.

SIR,—Evidently my letter in the "JOURNAL" for the 24th ult. has not convinced Mr. Dempster that his reminiscences of Houghton-le-Spring were not exactly according to facts, nor does he appear to believe the truth of what I then stated, and seems to think my letter went to prove the accuracy of his remarks.

His confirmation of my statement *re* Collector *v.* Manager goes to prove I know something of the place; and he asks, "Where were the Directors, if any?" I now give him the names of the Directors who asked the Manager to visit their works and report on the same (as they were very much dissatisfied then with the works generally). They were: Mr. Hopper, of the Fence Houses Iron-Works, and Mr. Robson, of the Brewery, Houghton. I am sorry Mr. Dempster thinks I have hid my head under a bushel. I do not see why I should. One of these Directors told the writer in 1879—nearly five years after the change took place—that "he was so disgusted with the way the money had been spent on the place, that he had given up his position as a Director, and had sold his shares." Mark, sold, not abandoned, his shares! I did not ask the price, or I might have been able to show that the shareholders considered the works of some value.

I could, if permission was given me, name two well-known gentlemen in charge of gas-works to-day making between them over 1500 million cubic feet, who both had some hand in the appointment. The Manager, who had the appointment in his hand, was writing one of these gentlemen on private business, and casually mentioned he was looking for a Manager for Houghton. Next day he had a letter written offering the place to the then Manager of Tillicoultry, when a wire message arrived: "Have a man for Houghton. Writing you." The letter duly arrived, a meeting was arranged, and this resulted in the sender of the message writing to Mr. Meiklejohn of the place, and asking him to communicate direct with ——, and say what day he could come over and see him about it, which he did. Thence the facts as I stated, of his stay and the drive. Perhaps were Mr. Dempster to see the receipt for the hire, he would be convinced his friend was not so far in the background as he imagines. He further accuses me of having "tried to spoil Mr. Meiklejohn's good name behind a bush." I can only say I intended nothing of the kind—"evil be to him who evil thinks"—and I think Mr. Dempster has no foundation for such a statement, as, if Mr. Meiklejohn's name was dragged into it, it was only to state the truth, and nothing but truth. I can give further proof of knowing something of the place, if needed; and facts are "stubborn chields to ding," even if under the signature I meantime prefer.

TRUTH ONLY.

June 6, 1904.

Comparative Cost of Gas and Electricity.

SIR,—Referring to the letters under this heading in last week's "JOURNAL," it was satisfactory to note that the "Daily News" Editor, at any rate, so little misapprehended the point of Mr. Brown's data and remarks that this gentleman's explanatory letter and virtual challenge were followed by the significant sentence, "This correspondence is now closed."

Mr. Brown did service in replying to the "Daily News" article, which so unfairly compared the two illuminants. No little advantage would accrue to the gas industry were his example persistently followed whenever such articles appear. The fact that most of us, when lacking personal knowledge, are more or less ready to accept newspaper statements as gospel, is indicative enough of the mischief that may be done by uncontradicted comparisons of this nature.

ROBERT WATSON.

Doncaster, June 11, 1904.

The Law of Bankrupts' Gas Accounts.

SIR,—With reference to the power of a statutory gas undertaking to refuse to supply to a trustee under deed of assignment, you state that the law is perfectly clear on this point, and quote "Michael and Will," Fifth Edition, p. 83. The case therein quoted appears, however, to refer to the trustee in bankruptcy, and not under deed of assignment. I have always held that a trustee under a deed of assignment is not an occupier unless he has entered into a new tenancy agreement with the landlord, that the debtor is still the consumer, and, of course, the company could refuse to supply until the arrears were paid.

If I mistake not you have also advocated this view in a previous issue of the "JOURNAL."

A CHIEF OF RENTAL DEPARTMENT.

June 9, 1904.

[The law appears to be as stated by our correspondent. If the words "in bankruptcy" had been added after "trustee" in our previous article, the point would have been fully covered. For a fuller discussion of the law on the subject, which is not without some ambiguity, reference may be made to the "JOURNAL" for Feb. 18, 1902, p. 404.—ED. J.G.L.]

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following further progress has been made with Bills:—

Bills brought from the Commons, read the first time, and referred to the Examiners: Local Government Provisional Orders (Gas) Bill, Lytham Improvement Bill, North-Western Electricity and Power Gas Bill, Skipton Water and Improvement Bill.

Bills read a second time: Gas Orders Confirmation Bills (Nos. 2 and 3), Gas and Water Orders Confirmation Bill, Water Orders Confirmation Bill.

Bills read the third time and passed: Brixham Gas Bill, Colney Hatch Gas Bill, Derwent Valley Water Board Bill, Gomersal Gas Bill, Kirkby-in-Ashfield Urban District Gas Bill, Littlestone-on-Sea and District Water Bill, Newcastle and Gateshead Water Bill, Sheppey Gas Bill.

The Gas Orders Confirmation Bill has been referred to the Select Committee, consisting of the Earl of Dartrey (Chairman), the Earl of Dartmouth, the Marquis of Winchester, Lord Monson, and Lord Digby, who are now sitting.

The Barnet District Gas and Water Bill and the Doncaster Corporation Bill have been referred to a Select Committee, consisting of the Duke of Northumberland (Chairman), the Duke of Wellington, Lord Tenterden, Lord Emly, and Lord Cranworth; to meet on Thursday.

HOUSE OF COMMONS.

The following further progress has been made with Bills:—

Lords Bills read a second time and committed: Barrow-in-Furness Corporation Bill, Filey Improvement Bill, Preston Corporation Water Bill, Ticehurst and District Water and Gas Bill.

Bill reported: Swindon Corporation Bill.

Bills read the third time and passed: North-Western Electricity and Power Gas Bill, Skipton Water and Improvement Bill.

GLEANINGS FROM THE COMMITTEE ROOMS.

The Bermondsey Clause.

THE Lea Bridge Gas Company and the Swindon Gas Company have been contesting respectively with the Leyton District Council and the Swindon Corporation for the insertion of the Bermondsey clause in the Bills of these Local Authorities; but in neither case—the matter was discussed before the Police and Sanitary Regulations Committees of the Commons—did they meet with the success that the Gaslight and Coke Company gained in connection with the Marylebone Bill without, in the second trial, much trouble. The cases were well conducted for the Companies by Mr. A. M. Paddon on the Leyton Bill, and by Mr. J. Shiress Will on the Swindon Bill. In the Leyton Bill, the Council contemplate the supply of electrical energy in bulk to outside districts, and to furnish electrical fittings; while the Swindon Corporation are applying for an extension of their electric supply area, as well as power to supply fittings. A startling fact brought out in the discussion of the Leyton Bill was that the ratepayers have had to provide some £8432 to meet losses on the electricity undertaking. This alone is a sufficient justification for the insertion of the clause; but success was not the portion of either of the opponents on this occasion.

Selby Defeats Leeds. There was a sharp bout between the Leeds Corporation and the Selby District Council, before Sir H. Aubrey Fletcher's Committee, from Tuesday to Thursday last, over the clauses in the Selby Council's Bill in which they propose to sink a new well at Brayton Barff, and to construct a reservoir and other works. The leading engineering witness was Mr. Percy Griffith, who had reported upon the supply of Selby, and had recommended the present scheme – the quantity and quality of the supply from the present works being of a very dubious character. The calculations of Mr. Griffith as to prospective requirements work out roughly to 500,000 gallons per day. To provide this, he recommends a boring at Brayton Barff about 400 feet deep. This he proposes to line for a depth of 100 feet, thus making it water-tight to that extent, and avoiding the risk of serious pollution. In the event of the supply not being sufficient, provision is made for sinking another shaft to a depth of 150 feet. The proposed reservoir will have a capacity of 750,000 gallons. The total estimate for the new works amounts to £30,000. Mr. B. M. Gray, the Water Engineer of Selby, Mr. George Hodson, Mr. F. J. Bancroft (the President of the British Association of Water-Works Engineers), Mr. Baldwin Latham, Dr. Thresh, and Mr. W. Whitaker, were among the experts called in support. The Leeds Corporation have a large estate at Gateforth, which they may utilize in a manner that they contend would be prejudicial to the proposed well in respect of pollution, and so they did not want the well in their neighbourhood. They described the scheme as a problematical attempt to get water, and tried to incite the Committee to an adverse opinion on the Bill by painting the fearful consequences to the well if mineral workings should come near it—and minerals, it was asserted, do undoubtedly exist under the Corporation estate. The Committee declared in favour of Selby.

A Water-Works Tramway. A tramway about a mile in length, which purposes to give faculties for carrying materials for the construction of a large reservoir and so cheapening the cost to the ratepayers of Manchester, was on Thursday last debated before Lord Hawksbury's Committee, in connection with the Manchester Corporation (General Powers) Bill. For the greater part of its length, the tramway will run through the property of Lord Derby; and his Lordship was the only opponent. The Corporation proposed to be bound to reinstate in seven years Lord Derby's property. The work has connection with the Thirlmere scheme. By 1910—as explained by Mr. G. H. Hill, the Chief Engineer—the second pipe-line now being laid will have to be supplemented by a third one. A storage reservoir for 500 million gallons is needed at Heaton Park (the reservoir for which the tramroad is required); and the estimate for the work amounts to £1,215,000. Sir Benjamin Baker and others were called in support. The Committee found the preamble proved.

A Question of Locus Standi. The Woking Water Company were before the Court of Referees on Thursday afternoon seeking *locus standi* against the Guildford Borough Extension Bill. The proposal upon which the Company petitioned to be heard may have the effect of their being called upon to surrender about 1900 acres of their area of supply; but the Company's own Act of 1899 contains a clause behind which the Court felt they could not go. In the year named, the Company sought an extension of their powers; and the Guildford Corporation then foreseeing a probable extension of the borough area, secured the insertion of a clause which gave the Corporation power to purchase the portion of the Company's undertaking within the extended area. The *locus standi* was refused.

THE SHEPPEY GAS BILL.

In the "Gleanings from the Committee Rooms" on May 17 (p. 452), there appeared some comments on the opposition to the above Bill. The "Sheerness Times and General Advertiser" reproduced the remarks; and the publication in the local paper was brought to the notice of the Solicitors for the opponents (Messrs. Biggs-Roche, Sawyer, and Co., of Lincoln's Inn Fields, W.C.). They have sent a reply to the "Advertiser," and forwarded a copy to us—asking for publicity to be given to it in our next issue. We have pleasure in complying, and in appending a few notes on the communication, which will show that our correspondents have not much to congratulate themselves upon, nor to complain of in respect of our previous statements.

THE EDITOR "Sheerness Times and General Advertiser."

Sir,—We regret to notice in your last issue the insertion of an extract from the "JOURNAL OF GAS LIGHTING." We say regret, because of the apparent animus of the writer; but, unfortunately for your readers, the article is, from beginning to end, incorrect and misleading as to the facts, which are very much distorted.

We think in our previous correspondence upon the same matter (which you kindly inserted, and which was incontrovertible), that we clearly explained the facts. When the proposed Sheppey Gas Bill was brought forward, and came to our knowledge, we, on behalf of our clients, at once placed ourselves in communication with the Solicitors to the Company, with the most friendly intentions, and were anxious not to inconvenience the Company more than could possibly be avoided, so long as the new Bill did not in any way apply to our clients' property at Leysdown; and we did not for a moment then think that we could go further than to ask the Company to eliminate from their Bill all clauses which might affect our clients' land. But our overtures were met in a most unfriendly and contemptuous spirit, and refusal given to eliminate any clauses whatever from the Bill, though just previous to the Bill coming before the Committee, certain clauses were withdrawn without reference to us.

Had the Bill been drawn so that it did not in any way affect our clients' land, no opposition would have been made by us—in fact, we did not then think any opposition would avail, if our clients' land was not affected by the Bill; and it was only by manipulation upon the hearing of the petition that we obtained such success with regard to the "time limit," at which we were ourselves somewhat surprised. But we observed the feeling of the Committee, as expressed by the Chairman, that it was perfectly natural, as our clients were developing their own land, they would wish to do the lighting on their own property, without interference from other parties having no interest therein.

Our clients were aware of the possibility in the future of gas being at some time required at Leysdown, and that they would require to find a supply if needed. They naturally would have welcomed the Sheppey Gas Company if they thought they could have supplied it at a proper and moderate price; but they thought, and were told, that the Sheppey Gas Company, for many reasons, could never afford to bring their mains to Leysdown, and supply gas at a price at which it could be manufactured on the spot. Our clients, naturally, in contemplation of any possible future arrangements, could not permit the Gas Company to obtain any further powers, which might prejudice our clients obtaining any future parliamentary or other powers they might hereafter subsequently desire to obtain. Though the Sheppey Gas Company, with their Act, could not stop our clients forming a Company, with or without parliamentary powers, and supplying Leysdown with gas, it is very doubtful if any gas will ever be required, as lighting and cooking can be done so much better by electricity.

Our clients' opposition to the Sheppey Gas Bill was effectual, seeing that all clauses having reference to our clients' land were eliminated, and, in addition thereto, other clauses referring to the further powers sought by the Gas Company were struck out of the Bill, without any desire on our clients' part. All that our clients required was to say to the Gas Company "hands off our land," which was fully recognized and granted by the Lower House. So how the writer of the article in the "JOURNAL OF GAS LIGHTING" can verify his statement that the opponents were beaten in the Lower House, it is very difficult to understand, because our clients obtained all they could reasonably expect and desire. Our clients were so encouraged by their success in the Lower House—the Committee there being anxious to secure to our clients a time-limit, under the Gas Company's Act, 1871—that they felt sure of obtaining such time-limit in the Upper House, if they endeavoured to obtain it; but, by our advice, they did not proceed further than filing their petition, as we considered the expense of the hearing not worth the cost, even if our clients were successful.

As we have before stated in our previous correspondence, had the Sheppey Gas Company left out of their Bill all reference to our clients' land, there would have been no opposition on their part, and no cost would have been incurred. The Gas Company determined, against our wishes, to make their new Bill apply to the Leysdown land, but virtually failed to do so; and in

their failure they lost the other powers they had applied for, and which our clients had no desire to oppose. So we can only leave it to your readers to judge which were the successful parties.

We could criticize at great length the article in the "JOURNAL OF GAS LIGHTING," but content ourselves with giving the real facts, which apparently are little known to the writer of the article, who also speaks of the Committee of the Lower House disallowing our clients' petition, when, as a matter of fact, the Committee of the Lower House cleared their room and debated at some length as to giving our clients their costs—a somewhat unusual course. They were no doubt of opinion the application made by us for costs was worth the consideration; and certainly it should have been granted, for it is very difficult to understand on what grounds any company could have the audacity to interfere with our clients' rights in respect of their own property, without any invitation from the owners. It is like a stranger dictating to a householder as to the light he shall use in his house, and at the same time refusing to supply him.

In the article in question, the keynote appears to be given by the word "compensation" as to the reason for the Gas Company adhering to their worthless powers, which they obtained in 1871, in respect of Leysdown, and which, though they could never exercise, they apparently will not relinquish. We do not propose, however, to allow our clients to pay money without receiving some benefit, though they will be pleased if the Sheppey Gas Company will bring their mains and supply gas at Leysdown as soon as they please. But the mains will have to be supplied at the cost of the Gas Company; and if they charge too much for their gas, we anticipate the householders will prefer electricity.

The Gas Company will never incur the cost of bringing their mains to Leysdown. But no doubt steps will be taken by our clients later on, when occasion requires, to apply to Parliament in respect of water, as well as lighting; and then, if gas should be wanted, which is very unlikely, it will be a very simple matter, if necessary, to take powers in respect of gas as well as other modes of lighting.

We apologize for the length of this letter; but we think it is evident that the real facts connected with the matter should be clearly explained to any interested party.

BIGGS-ROCHE, SAWYER, AND CO.

Charming simplicity and well-assumed injured innocence are the conspicuous features of this outpouring of our correspondents. We can quite understand their indignation against adverse comment; seeing that their clients obtained so little for what must have been a somewhat considerable expense for the "Leysdown and Shellness Estates, Limited." The injudiciousness of their opposition is shown by themselves very clearly when they say: "Though the Sheppey Gas Company, with their Act, could not stop our clients forming a Company, with or without parliamentary powers, and supplying Leysdown with gas, it is very doubtful if any gas will ever be required, as lighting and cooking can be done so much better by electricity." If the first and second assertions in this statement are true, then it follows that the Estates Company named were ill-advised in spending their money in opposing the Gas Company; and were we the Estates Company, there would, upon this statement, be an imperative demand for an explanation. The whole paragraph from which the quoted statement is taken discloses ignorance as to gas distribution and a want of knowledge of the relative merits of gas and electricity for both lighting and cooking. Our correspondents describe the previous reference to their opposition of the Sheppey Bill as "incorrect, misleading, and distorted," which epithets reflect somewhat on our veracity. We will not be so discourteous as to adopt a like bluntness by stating, in as few words, our opinion as to their present communication. There is no occasion to discuss with them whether the manner in which they approached the Company at the outset was friendly or (shall we say?) irritating. But we may point out that the weakness of their case is clearly shown by the fact that the present Bill contained no reference to Leysdown, as the Gas Company's powers there were obtained in their 1871 Act; but in the present Bill the Company proposed the correction of an omission from that Act by including the parish of Minster. In the House of Commons, the Gas Company very properly objected to the *locus standi* of the Estates Company; but the Court of Referees allowed them to appear against clauses 44, 48, and 62. We find that clause 44 refers to the utilization of land for manufacturing purposes adjoining the Company's present works; clause 48 has reference to the manufacture, &c., of power gas; and clause 62 alludes to the repeal of certain sections of the 1871 Act, which would be at variance with the provisions of the present Bill. Clauses 44 and 62 were objected to technically by the Lord Chairman; clause 44 was dropped; and clause 62 amended. Therefore, the Estates Company only had clause 48 to speak upon. To get rid of all opposition, the Gas Company relinquished the power-gas clause, as it was not likely to be of much value to them. Apparently, the Estates Company seem to think the Lord Chairman should have consulted them about the alterations he wished to make. As already stated, the Bill did not affect the Estates Company's land at all; and they scored no success over the time-limit, seeing that the Committee did not insert one. Our correspondents again appear to be labouring under some strange conception of the mind, which we cannot understand, when they say that "our clients' opposition to the Sheppey Gas Bill was effectual, seeing that all clauses having reference to our clients' land were eliminated." There were no clauses in the Bill referring to Leysdown; none were taken out on account of the Estates Company; and the only further power sought, which was dropped, was the power-gas clause. Their right to object so far as Leysdown was concerned was not recognized by the Lower House; excepting, in the circumstances previously stated, on the clause asked for in respect of the supply of power gas. The writers of the lengthy effusion from Lincoln's Inn Fields complain of the Gas Company with (in our independent judgment) little reason; but the Gas Company have real cause for complaint against the opposition. They shout of their "successes" in the Lower House (successes which a microscopical examination fail to reveal); yet they lodged a petition in the Upper House, but not until the morning when the Bill was to come before an Opposed Committee of that House, did the Gas Company know that their opponents were not proceeding with their objection. Only very occasionally, are discourteous opponents found. Of such, are this Estates Company. The Gas Company will no doubt be quite prepared to go to Leysdown as soon as there is the necessary demand for gas, which is always a condition precedent to the provision of a supply of any kind.

COURT OF REFEREES.—Thursday, June 9.

Local Government Board Provisional Order (No. 11) Bill. The Water Supply of Guildford.

This Bill came before the Court to-day—Mr. PARKER SMITH presiding—on the objection of the promoters of the Guildford Order.

Mr. FRERE said that the object of the part of the Bill involved in the present case was to increase the area of the borough of Guildford from 680 to 2816 acres, or practically to quadruple the size of the borough. The Woking Water and Gas Company, for whom he appeared, were supplying water within the area proposed to be added, and 1899 acres of their area of supply were included in the addition. The rents they obtained from this district amounted to one-seventh of their total income. There were 16 miles of mains; and they had wells and pumping stations in the district in question. He submitted that, if these facts stood alone, they would be sufficient to entitle him to be heard in opposition to a new road authority being imposed upon his clients with power to break up streets and, it might be, interfere with their mains and pipes. But these facts did not stand alone. In 1885, the Water Company sought power to extend their area of supply so as to include part of the parish of Stoke. The Act provided that if within one year the borough of Guildford should be extended so as to include the parish of Stoke, which lay between the parliamentary and the then municipal boundary, and the Urban Sanitary Authority gave notice of their desire to purchase the undertaking in that area, they should be able to do so—should be able to purchase everything except that which might be necessary for the supply of other parts of the district. Following on this, the Bill which was in contemplation when this was inserted was passed; and in clause 54 provisions were laid down for the protection of his clients, requiring notice of purchase to be given within a month, and prohibiting the supply of water within the area until part of the undertaking of the Company had been purchased. This purchase had taken place. In 1899, the Company came to Parliament for a further Act, extending their works; and in this the Corporation of Guildford obtained the insertion of a clause (clause 38) providing that if the borough was extended so as to include any portion of the district then within the limits of the Company's supply, if the Corporation should within a year give six months' notice of their intention to purchase such portion of their undertaking, the Company should sell. The position, then, was that if Guildford was extended, the Company were bound to be called on to sell the portion of their undertaking in the added area to the Corporation, except such part as was required for supply elsewhere. When the Company agreed to this, naturally they had in their minds an extension similar to that which had taken place in 1886, which was an extension of some 73 acres. They had not in contemplation such an enormous increase as that proposed, which would have the effect of quadrupling the area of the borough. The Company had spent a large amount of money in recent years, and they certainly would not have laid out so much if they had contemplated this extension. The effect of the Bill would be to bring into play provisions which might take away a very large part of the Company's area of supply. It might deprive them of one-seventh of their income, 4000 or 5000 consumers, and 1900 acres of area, and practically sterilize to some extent the arrangements made in 1899 for extending the supply of the Company. This would be imposing great hardship on the Company; and, under the circumstances, he submitted that they were entitled to *locus*, so as to be able to go before the Committee to whom the Bill was referred and say: "You ought not to extend the borough of Guildford so as to affect us in this way."

Mr. BRYNMOR JONES said the Bill would not alter or amend the Company's Act of 1899.

Mr. FRERE said this was the case. On the Bill of 1885, it was decided that the Company, as owners and ratepayers, had *locus*; and a precedent was also to be found in the Halifax case in 1900. The Corporation objected to the *locus*, because they said they did not take land or property at all. Strictly speaking, this was true; but the effect of what they were doing would be to compel the Company to sell part of their undertaking. The Corporation said that the Provisional Order which the Bill would confirm would not affect the rights or interests of the Company, inasmuch as they were clearly defined in the Act of 1899—having in view the extension of the borough of Guildford. But this was the ground of his asking for *locus standi*. It was because his position was defined in 1899 that he said he should have *locus* to be heard against the present confirming Bill. He was placed under the obligation to sell by the Act of 1899. Then the promoters said that the Company were complaining of past legislation; but he did not want to touch past legislation. What he complained of was the proposed legislation, which would bring the past legislation into play in an entirely new manner, and in a way that was not contemplated when the Act of 1899 was passed. It was not of the former Act he complained, but that it should be made applicable to such an enormous area.

Mr. WORSLEY TAYLOR (a member of the Court): Do you contend that you would have a right to be heard even if the extension proposed were a moderate one?

Mr. FRERE: Yes; I say I should have the right to be heard against any extension at all. I deny that there was any intention to agree to sell so large a proportion of my undertaking as I should become liable to sell if this Order passes.

Mr. WEDDERBURN, in opposing the *locus* for the Corporation, said the question to be asked was what would be the effect of the proposed legislation on the existing rights of the parties? Would it alter these rights? Not at all. The position rested entirely on the Act of 1899. When this Act was passed, the Corporation foresaw that before long they would be extending their area; and their opposition was got rid of by the insertion of clause 38, which gave them power to buy so much of the water undertaking as was in the extended area. There was no question as to how many acres it was to be; and what the Company were now asking was that they should be allowed to say that they were dissatisfied with the former legislation.

Mr. WORSLEY TAYLOR: They would get compensation, would they not, for injury to the rest of their property?

Mr. WEDDERBURN said there would be an arbitration. The objection of the Company to the extension was that they would lose part of their area. But this was a matter of past legislation. The Corporation were proposing nothing not contemplated by the Act of 1899.

The CHAIRMAN: I do not see how you can go behind the Act of 1889.

Mr. WEDDERBURN: That is what we are asked to do.

Further discussion having taken place, the *locus* was disallowed.

POLICE AND SANITARY COMMITTEE.

Monday, June 6.

(*Before Mr.* J. W. WILSON, *Chairman, Mr.* LUKE WHITE, *Mr.* WHITLEY, *Mr.* BILL, *and Mr.* GRAHAM.)

SWINDON CORPORATION BILL.

Water Supply and Electric Light Matters.

The Bill promoted by the Swindon Corporation came before the above Committee to-day.

Mr. GERALD FITZGERALD, K.C., the Hon. F. THESIGER, and Mr. H. GAINE appeared for the promoters; the petitioners being represented as follows: Wilts County Council by Mr. HONORATUS LLOYD, K.C., and Mr. G. J. TALBOT, and the Swindon United Gas Company by Mr. SHIRESS WILL, K.C.

Mr. FITZGERALD, in opening, said the borough was incorporated in 1900, and was formed of two urban districts known as the Old Town of Swindon and the New Town of Swindon. It was co-extensive with the parish of Swindon, its area being 4246 acres. The population had very rapidly increased. In 1871, it was 11,520, and in 1901, 45,000; the estimated present figure being 48,000. The rateable value had also largely increased, having been £41,576 in 1871 and £185,600 in 1901; the estimated figure now being £210,000. The total rates in 1903-4 amounted to 6s. 11d. in the pound. The electrical, water, and tramway undertakings of the Council were in their infancy, however, and had yielded no profit hitherto; but it was beyond reasonable doubt that in a few years these undertakings would show such a profit as would materially reduce the rates. He would deal first with Part II. of the Bill, which related to water. The population of the water area was 52,460, in 1901, and the estimated population to-day was 55,000; so that, allowing 20 gallons per head per diem, the requirement was a million gallons daily. At present, the actual consumption was 16 or 17 gallons; but it was anticipated that this figure would increase in the future. There were a large number of houses, which, although they had water-closets, were not supplied at adequate pressure. The demand for bath supplies was increasing; and the Corporation anticipated being able to do more street watering than they had done hitherto. Assuming that the population increased in the next 16 years by 10,000, it would then be 65,000, which, at 20 gallons per head, would mean a requirement of 1,300,000 gallons per diem—a calculation which certainly did not err on the side of extravagance. The Great Western Railway were very large consumers of water. Hitherto the Company had had a supply of their own; and they had been able to assist the Corporation when they were short of water. There was reason to believe, however, that the Corporation could no longer depend on this assistance. There was an agreement under which the Corporation were bound, if required by the Company, to supply them with water when it was available after providing for the needs of the district. The existing works of the Company were situated at Wroughton; and they would give a supply of half-a-million gallons daily in winter, but only a quarter-of-a-million gallons daily in the dry months from June to October or November. What they had to provide for was the dry, and not the wet months. They must base their calculations on the minimum yield, which he took at 250,000 gallons. For some years, they had only been able to give an intermittent supply during the summer months; and even then they had been obliged to eke it out by purchase from the Great Western Railway Company. There were works under construction at Ogbourne, which it was calculated would yield half-a-million gallons a day. The Corporation sought by the Bill to extend their existing water supply, to take additional water from the valley of the Og, to construct new works, and to expend for these purposes a total sum of £10,000. The powers sought were, however, entirely permissive. The Wiltshire County Council, who opposed the water provisions of the Bill, did so on the ground that the powers sought were too wide, and might be exercised to the detriment and at the expense of other parts of the county. He should be prepared, in order to meet this opposition, to agree to a clause under which the Corporation would bind themselves not to purchase land for water purposes at a greater distance than 10 or 11 miles from the Swindon Town Hall.

The CHAIRMAN asked if this was the only proposal the promoters had to make by way of a compromise. The Committee would require very strong evidence before they gave an open, roving permission for the obtaining of water, especially as to pumping.

Mr. FITZGERALD said he was afraid that at Swindon they could not get water in any other way than by pumping.

The CHAIRMAN asked whether what the Corporation required was not practically an extension of the Ogbourne works. It would be an intelligible proposal to suggest that the operations under the Bill should be limited to a certain distance from the Ogbourne works, though he did not wish to be taken as assenting to the water clauses even under such conditions.

Mr. FITZGERALD said he should have preferred the powers in the Bill, which were quite practical and on all-fours with powers which had been given in other districts. It would meet the present requirements if they had to confine their operations to within 3½ miles of their existing new works.

Alderman *F. G. Wright*, the Chairman of the Water Committee of the Swindon Corporation, was called to give evidence in support of the water-works clauses of the Bill. He maintained that the present water supply was inadequate. If it had not been for the Great Western Railway Company, there might have been a water famine in Swindon. Insufficient water supply had been the cause of many industries declining to settle in the town.

In cross-examination by Mr. HONORATUS LLOYD, witness admitted that in some winter seasons a large quantity of water had run to waste from their Wroughton works. This water, however, was not good enough to store for use during the dry season.

By the CHAIRMAN: The Ogbourne works not being yet completed, he was unable to say how much they were capable of supplying.

After further evidence had been given,

The CHAIRMAN said that the Committee would consider anything scheduling an area of nine square miles.

Mr. *Whitaker*, examined by Mr. THESIGER, declared that an extension of the Swindon water supply was essential.

Mr. *Eaton* said it would be ridiculous in this district to adopt any other means of obtaining water than to go to the chalk strata and sink wells in it. One clause in the Bill took power to acquire by agreement 10 acres of land. This was a very common form of clause. The only objection to a "roving commission," as it was called, arose in cases where a large population might be interfered with; but this objection did not apply in the present case. The maximum quantity that could be obtained in dry weather from the works under construction at Ogbourne was from 650,000 to 750,000 gallons per day. The yield of the Wroughton works was only about a quarter-of-a-million gallons daily. The total available, consequently, was about 900,000 gallons daily; and it was necessary therefore to obtain further water.

The CHAIRMAN said that, before granting powers like those now sought, which included the haphazard purchase of land and other works and provisions in connection, they would want much more definite plans than had been laid before them. Therefore they were unanimously of opinion that they could not consider the preamble proved, so far practically as the purchase by agreement of the 10 acres of land was concerned.

Mr. FITZGERALD: That is clause 196.

The CHAIRMAN: Yes. I do not know how far this involves other clauses.

Mr. FITZGERALD hoped the other clauses would be passed, otherwise the Corporation would be in difficulties in regard to the land they already possessed. The decision he supposed would not affect clause 6, which would enable the Corporation, upon any lands for the time being belonging to them, to make and maintain certain subsidiary works which might be necessary or convenient in connection with their undertaking.

The CHAIRMAN said the Committee particularly felt, in regard to the proposed purchase of land, that it was necessary to guard all interests concerned; and therefore they would require much stronger evidence than had yet been given before granting this power, having regard to the underground pumping that would take place and the damage that might result in consequence. But any supplemental power connected with the plant or water-works which the Corporation at present possessed would come in a different category.

Mr. TALBOT said it was absolutely necessary for the protection of his clients that clauses 6 and 7 (the latter of which gave power to acquire by agreement easements, rights, &c., for the purposes of the water undertaking) should, in their present form, come out of the Bill. If a question of (say) extending or deepening an existing well was concerned, it would be another matter. But these clauses would do the very thing the Committee apprehended—enable the Corporation, wherever they had land, now or hereafter, to make water-works of any depth.

The CHAIRMAN said this was exactly what the Committee did not intend to allow.

Mr. FITZGERALD explained that some of the powers sought in these clauses were required to enable works in progress to be executed.

The CHAIRMAN said that if Mr. Fitzgerald could show that any of the powers asked for were required in connection with the water output, and were not included in the Provisional Order of 1902, the Committee would be willing to consider them; otherwise it seemed that the clauses in question must go. The Committee would not give power in the Bill enabling speculative purchases of land to be made for the purpose possibly of finding areas for water purposes. They did not consider that would be fair in the interests of the public at large.

Tuesday, June 7.

Mr. FITZGERALD, on the resumption of the proceedings this morning, said the promoters had arrived at an agreement with the Wiltshire County Council as to the form the clause bearing on the water undertaking should assume, or the modifications to be adopted.

Mr. *Hilton*, the Town Clerk of Swindon, was recalled and gave evidence as to the financial position of the town. He pointed out that a 1d. rate yielded a little over £800 on the assessable value, and that the Corporation had complied with all the statutory requirements, including the publication of notices, advertising, and the holding of public meetings of ratepayers.

Mr. FITZGERALD brought up the agreed clause with the Wiltshire County Council, and asked the Committee to sanction it in the following form: "Whereas doubts have arisen as to the powers of the Corporation to extend, enlarge and improve their water-works in the parishes of Wroughton, Ogbourne St. George, and Whitefield, and it is expedient to remove such doubts, be it enacted that the Corporation may, in the parishes of Wroughton, Ogbourne, and Whitefield acquire lands." A verbal amendment was suggested; but the clause was ultimately accepted in the form submitted.

THE SUPPLY OF ELECTRIC LIGHT AND FITTINGS.

Mr. FITZGERALD, in opening the case on Part III. of the Bill, dealing with electricity, said that in 1895 the predecessors of the Corporation—the New Town Urban District Council—obtained an Order

authorizing electric lighting within their district. In 1900, a Charter was granted to the Corporation, and the electric undertaking was vested in them, with the proviso in the Charter that the powers of the Order of 1895 should extend throughout the borough; so that the whole undertaking became vested in the Corporation for the benefit of the whole borough. In 1903, the Corporation began the supply. The opposition to this part of the Bill proceeded from the Swindon Gas Company who were allowed *locus standi* under Standing Order 129 of the House of Commons, which allowed them to give *locus* if they thought fit. The opposition was to the clause proposing to extend the area of supply of electricity for lighting purposes, and to the clause dealing with the supply of electric-light fittings. This was the new clause 27, which was as follows:—

(1) The Council may, within the area of supply as defined by this part of this Act, provide, sell, let for hire, and fix, set up, alter, repair, and remove, but shall not manufacture, lamps, meters, electric lines, fuses, switches, fittings, lamp-holders, motors, and other apparatus and things for lighting and motive power and for all other purposes for which electrical energy can or may be used or otherwise necessary or proper for the supply, distribution, consumption, or use of electrical energy, and may provide all materials and do all works necessary or proper in that behalf, and may require and take such remuneration in money or such rents and charges for, and make such terms and conditions with respect to, the sale, letting, fixing, setting up, altering, repairing, or removing of such lamps, meters, electric lines, fuses, switches, fittings, lamp-holders, motors, and other apparatus and things as aforesaid, and for securing (both as regards the consumer and third parties) their safety and return to the Council as the Council may think fit, or as may be agreed upon between them and the person to or for whom the same are sold, supplied, let, fixed, set up, altered, repaired, or removed. Provided that nothing in this section shall authorize the Corporation themselves to fix upon any consumer's premises electric light fittings or electric wiring other than may be required to complete the service line between the Corporation's supply mains and their own apparatus upon such consumer's premises.

(2) Any expenses incurred by the Council in carrying into effect the provisions of this part of this Act shall be deemed to be expenses incurred by the Council under the Electric Lighting Act, 1882, and not otherwise provided for, and the provisions of sections 7 and 8 of that Act shall extend and apply accordingly to such expenses.

(3) Any moneys received by the Council under this part of this Act shall be applied in manner provided by section 52 of the Swindon New Town Electric Lighting Order, 1895, except capital moneys, which shall be applied in manner provided by section 53 of the said Order.

(4) No electric line, fuse, switch, fitting, meter, lamp, lamp-holder, motor apparatus, or thing let for hire by the Council shall be subject to distress or to the landlord's remedy for rent, or to be taken in execution under any process of law or equity or any proceeding in bankruptcy against the persons or person in whose possession the same may be. Provided that such electric line, fuse, switch, fitting, meter, lamp, lamp-holder, motor apparatus, or thing is marked or impressed with a sufficient mark or brand indicating the Council as the actual owners thereof.

The Gas Company asked that, in place of this, what was known as the "Bermondsey Clause" should be inserted, under which the Corporation would be obliged to supply every year a financial statement or budget showing that the income covered the expenditure. It was doubtful whether their *locus* covered this point; but he would not raise objection on that score. The proposal as to extension of area was simply to make the electric limits co-extensive with the water limits, and was practically to include what might be called the suburban parishes of Swindon. There was reason to believe that there would be a demand for electric lighting in these parishes, and that the Corporation would be in a position to meet the demand. At the present moment, the Gas Company had a monopoly in the outside area, and were charging their suburban consumers 6d. per 1000 cubic feet more than within the borough. The gist of the Gas Company's opposition was in the paragraph in which they said that the extension of electric lighting powers to the outside parishes could not be remunerative; and that the Gas Company, as ratepayers, would be compelled to contribute towards the cost of an unremunerative undertaking which was competing with themselves. This, they contended, was unfair, and ought not to be sanctioned. As to the prospects of extension. The Corporation had started originally with 40 consumers, taking the equivalent of 2700 8-candle power lamps; but there were now 194 consumers, taking the equivalent of 9525 8-candle power lamps. They proposed to supply their tramways with electricity when they started running on Oct. 1. The question of the charge to the rates was one not for the Gas Company, but for the ratepayers. Parliament had sanctioned the thing. Electric lighting was more healthy than gas, particularly in small houses; and a good light was to a poor man one of the greatest comforts which could be brought to him.

The CHAIRMAN asked if Mr. Fitzgerald's argument implied that they were looking forward to putting the electric light into the dwellings of artizans?

Mr. FITZGERALD said he understood that the Corporation hoped to do this very extensively. The people were willing to take the supply, and the Corporation were willing to give it. As to clause 27, there were numerous precedents for it. Swindon was practically a working-class town. There were 2500 houses of £8 and under, 5000 of between £8 and £10, and 1900 of between £10 and £15. Many of these small occupiers owned the houses they lived in, and this was one reason why they anticipated that the electric light would be used by the artizan class. At present, if they took it they had to pay for the fittings; but the Corporation wanted to enable them to spread the expenditure over a number of years—themselves supplying the fittings, and taking quarterly payments. The question raised by the Gas Company was really one of competition; and he contended that this had already been decided by Parliament. The Gas Company asked for the "Bermondsey Clause;" but Section A of the present Committee had just refused to assent to that clause in the case of Leyton—a much stronger case for the clause than that of Swindon. The effect of the clause would be disastrous to the management of an undertaking of this sort. A commercial undertaking could not be managed on the principle of balancing the revenue of a year with the expenditure for that year.

The CHAIRMAN: You would have to "influence" your estimates?

Mr. FITZGERALD: Yes, jockey the account.

Mr. *J. G. Griffin*, the Electrical Engineer to the Corporation, gave evidence in support of Mr. Fitzgerald's statement. He said that none of the outside districts it was proposed to supply with electricity were large enough to have a generating station of their own. It was proposed to supply the fittings, but to have a contractor to do the wiring.

The CHAIRMAN: You desire to be able to finance the customer?

Mr. FITZGERALD: Yes. The clause we propose is the Kettering clause practically.

Witness then went on to say that consumers might elect to be charged either at a uniform price of 5d. per unit, or upon the maximum demand system. This system was as follows: The consumer would pay for all current he consumed at the rate of 2d. per unit, and, in addition, he would pay a capital sum each quarter depending on the maximum current which his indicator showed to have been used at any time during the quarter. This capital sum was fixed at the rate of £7 10s. per annum per kilowatt. The "Bermondsey Clause" was unacceptable, because it was essential that the charges should have the element of permanency. If they were compelled to raise their price, the effect would be to choke off consumers.

In cross-examination by Mr. SHIRESS WILL, witness said that the area it was proposed to add would amount to 12,335 acres. The population of the whole district was mostly composed of artizans and agricultural labourers.

The CHAIRMAN: Are these villages being supplied with gas?

Mr. SHIRESS WILL: Yes; but it is a rural district, and they have not adopted the Lighting Acts yet.

In further cross-examination, witness went on to say that the Corporation had issued a pamphlet containing the following passages: "Owners and occupiers of premises can have an installation put in their premises by any of the above contractors on entering into the necessary agreement with the Corporation, and giving security, by surety or otherwise, for payment of the cost of the same, and the Corporation will pay the contractor the cost of the installation provided it does not exceed £15. The owner or occupier will then repay the Corporation the amount paid by them to the contractor, with interest thereon at 5 per cent. per annum, by equal quarterly payments spread over a period of three years. . . . In the case of cottage property of a rateable value not exceeding £10, the agreement will only be made with the owner of the property and not with the tenant."

In re-examination by Mr. FITZGERALD, witness said he should object to restrictions such as would be imposed by the "Bermondsey Clause" being put on them in managing their commercial undertaking.

By Mr. WHITLEY: The free-wiring system was not in existence in Swindon. It had been proposed; but the ratepayers had objected. He did not think it would be necessary to come to Parliament to borrow the money it was proposed to advance to the consumers for wiring. The sum would not be large—only £3 10s. in each case. So that £350 would be sufficient for 100 houses. They would be content to hire out the fittings as gas companies hired out stoves; but it would be more fair to the consumers to sell.

Mr. FITZGERALD said this completed his case in regard to the competition of the Gas Company.

The CHAIRMAN (without calling upon Mr. Shiress Will) said the Committee did not feel there was any case for extension of the areas. He might say that they did not give this decision solely on the opposition of the Gas Company, because they had arrived at their conclusion before they had heard anything of their opposition. The Committee's decision was simply founded on the ground that there was no evidence of the necessity of extension. In the future, in due course, evidence might be forthcoming when the subject could be reconsidered. The Committee were not disposed to put the "Bermondsey Clause" on the promoters, but were disposed to give them the fittings clause, subject, of course, to what Counsel might advance.

Mr. SHIRESS WILL asked the Committee to reject the fittings clause, on the ground, first, that it was not an expedient thing to give a local authority this power, and, secondly, that it was not consistent with the declared policy of the Corporation to make the owner security for the cost of the fittings in the case of houses of a certain rateable value. He asked the Committee whether they would agree to the insertion of the following paragraph, which was added to the "Bermondsey Clause" in the case of the Marylebone Bill of last year: "There shall not be made against the general rate in respect of street lighting or other municipal purpose for which energy shall be employed a charge at a higher rate than that charged to consumers using energy for the like hours of supply."

Mr. FITZGERALD objected to the proposed addition, which, he said, was, in effect, the "Bermondsey Clause" pure and simple.

The COMMITTEE decided that, instead of the proposed fittings clause, which was inconsistent in its provisions, clause 9 of the Willesden Bill should be adopted. This clause was similar in effect to that in the Bill, but worded differently, and, in their opinion, more consistently in its parts.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Tuesday, June 7.

(*Before Mr. Justice* FARWELL.)

The Hessle Gaslight and Coke Company and Electric Lighting.

This was a petition asking the Court to sanction, under the Companies (Memorandum) Act, 1890, certain alterations in the Memorandum of Association unanimously approved by the shareholders.

Mr. JENKINS, K.C., and Mr. J. K. YOUNG appeared in support of the petition; Mr. CANN opposed it.

Mr. JENKINS said the Company was formed and registered under the Companies Acts, 1856 and 1857, but had never been registered under the Act of 1862. The Memorandum of Association had the merit of brevity, as the only objects specified therein were to manufacture and sell gas and coke. The capital was £21,000, divided into shares of £15 each;

and they now stood at £26—dividends at the rate of 10 per cent. per annum having been continuously paid. The Company desired to obtain powers to carry on the business of the production and sale of electricity, to deal with the residual products of gas manufacture, to supply fittings to consumers, and to raise capital; the main question being the combination of an electric light business with that of the manufacture of gas. The locality in which the Company carried on their operations was rapidly increasing, and it was believed that if the new powers were obtained many persons would have their houses fitted up with the electric light.

Mr. CANN said he appeared for the Local Authority, who were large consumers of gas, to oppose the petition; his clients having applied to the Board of Trade for a Provisional Order to supply electricity.

Mr. JENKINS urged that as the Local Authority were neither shareholders nor creditors, they had no *locus standi*.

His LORDSHIP upheld the objection.

Mr. JENKINS said he was not aware that any of the London Gas Companies had obtained power to supply the electric light, but several Provincial Companies had done so.

His LORDSHIP asked whether the shareholders realized that acquiring this power meant a large increase of capital.

Mr. JENKINS said they were perfectly aware of the fact, and there would be no difficulty in raising the necessary money, as the shares stood at a high premium. The main object of the Company was to supply "light;" and if people wanted the electric light, it was only reasonable that the Company should be able to supply it.

His LORDSHIP made an order confirming the resolutions.

BOW COUNTY COURT.—Wednesday, June 8.

(*Before His Honour Judge* SMYLY, K.C.).

Clark v. The Gaslight and Coke Company—An Important Point under the Workmen's Compensation Act.

This was a claim for the revision of an award under the above-named Act. It was before the Court on the 13th ult. (*ante*, p. 454), when his Honour reserved judgment. This was given to-day.

Mr. W. M. THOMPSON appeared for the applicant; Mr. A. NEILSON represented the respondents.

His HONOUR, in giving judgment, said: This is a case under the Workmen's Compensation Act, where a workman has applied to reinstate an order for £1 a week which at one time had been made in his case, and which had been reduced to 14s. 9d. upon his receiving work at which he earned a certain amount of money. It raises a question as to which, so far as I know, there is no direct authority to help me; and, shortly, the question is this: He is fit to do certain work, but that particular work is not the work he did previous to his being injured, and it is work at which there is a limited amount of employment, and a large number of persons who are applying for it. The question, under these circumstances, is whether I can take into consideration, in addition to the man's physical condition, the want of work in that particular business. I think it is a matter which is very likely to go elsewhere, and therefore I have put down my findings in writing, so that, should it do so, the Court above will have before them exactly what I find in the matter. I find: (1) That George Clark, the applicant, is not now, and has not been, capable of earning wages as a gas-works coal porter since the accident on Dec. 16, 1899, when he lost part of four fingers of his left hand. (2) That the condition of the hand is the same as when the award of April 1, 1901, was made. (3) That the applicant is now capable of earning wages as a gatekeeper, timekeeper, watchman, or any similar work where full use of the hand is not required. (4) That the above-mentioned employment is absolutely different work from that in which the applicant was engaged prior to the accident on Dec. 16, 1899. (5) That the applicant has made in good faith reasonable efforts to get such employment as that mentioned in my third and fourth findings—that is, employment as a gatekeeper, timekeeper, or watchman—and has been unable to get it. (6) That though the applicant may from time to time be able to earn something at odd jobs (such as the four days' harvesting, when he earned 15s.), yet the average earnings for the same would come to a very small sum per week—at the most not more than 5s. On the above findings, I hold that the applicant is entitled to have the compensation of £1 a week restored. If the applicant had been able to go back to the same employment as that in which he was engaged before the accident, the want of work in that employment might not, I think, be properly taken into consideration. But when a man, by his accident, is compelled to leave his own work, and take up another branch of work which is overstocked, then, in arriving at the amount which he is able to earn after the accident, the Court ought, I think, to take into consideration the fact that he has not been able to get employment at this new work. The applicant's evidence only confirms the experience of this Court again and again in other cases—namely, that employment as a gatekeeper or timekeeper is now almost impossible to get; and the difficulty is increasing daily, owing to the working of the Workmen's Compensation Act. The case of *Irons v. Davis and Simmins*, reported in 1899 (2 Q. B., 330), lays down that the test of the right of a workman to a weekly payment is the man's wage-earning capacity. I do not think that, in a case where a man has to leave his own class of work for another, physical ability alone ought to be looked at. It is to be hoped that if this case does go to the Court above, as I hope it will, one will get some little assistance from what the Court of Appeal says, as to whether one ought to take into consideration the want of work in an employment to which a man is driven, when assessing what he can really earn. The award therefore will be in favour of the applicant for £1 a week from the 11th of April last, the time when he made the application for the £1 a week to be restored; credit to be given for payments, if any, received since that date. The costs of the applicant to be on Scale C.

It was agreed that payments had been made up to date at the rate of 14s. 9d. per week, for which credit would be given to the respondents.

MISCELLANEOUS NEWS.

EXAMINATIONS IN GAS MANUFACTURE.

The Pass List.

The Superintendent of the Department of Technology of the City and Guilds of London Institute (Sir Philip Magnus) has issued the Pass List in connection with the last examinations in "Gas Manufacture." The following are the names of the successful candidates:—

HONOURS GRADE.

First Class.

Bates, W.	Cooke, D.	Hazell, H. D.	Robinson, F. H.
Beaumont, T. H.	Dean, W. E.	Hornby, J. F.	Rule, H.
Bell, W. R.	Duxbury, W. T.	Hunter, D.	Snelgrove, L. M.
Burgess, H.	Fielden, W.	Kaye, F. H.	Taylor, F. W.
Burton, H.	Garsed, E.	Kellock, A.	Twigg, W.
Chalmers, R. B.	Higham, H.	Lumb, H. D.	Ward, P.
Chree, R. H.	Harston, V. E.	Matthews, F. A.	Wynne, J. C.
Clark, F. W.			

Second Class.

Allen, P. T.	Foster, E.	Johnston, R. W.	Roper, C. T. B.
Anty, J.	Gill, G. M.	Kershaw, J.	Stones, E. E.
Ballingall, J. M.	Gillett, E.	Mackay, A.	Tooms, D. W.
Banks, H.	Griffin, C.	McCall, W.	Vince, E. P.
Brooke, J. B.	Hanson, W.	McCrae, J. P.	Walmsley, G.
Browning, R. A. S.	Harvey, D. H.	Nield, T. H.	Wardell, R.
Canning, T. F.	Heathcote, A. W.	Parrat, J.	Wedd, F. H.
Duckenfield, G. W. H.	Hepburn, J.	Prince, O.	Whitaker, L. V.
	Herman, W. J.	Prince, R. S. P.	Wilkinson, E.
Danphy, A. L.	Holt, J. E.	Randall, E. I.	Woodcock, T. H.
Fenner, R. L.	Jennings, A.	Randall, H. J.	

ORDINARY GRADE.

First Class.

Ashworth, H.	Cox, W. J.	Jennings, G. R. M.	Priestley, A.
Aston, W. G.	Currie, D.		Robson, J.
Bell, B. J.	Delafield, F. W.	King, A. G.	Roper, J. W.
Blackburn, L. J.	Donaldson, J. H.	Lister, A.	Saville, F.
Booth, W. N.	Easson, W. S.	M'Lusky, J. W.	Shaul, W. E.
Brearley, J. W.	Edwards, P.	McNicholl, J.	Somerville, D. A.
Bridge, J.	Fell, J. W.	Meredith, A. J.	Thompson, J. W.
Brown, W.	Grimwood, E. E.	Mosley, L. D.	Turner, H. O.
Browne, F.	Halstead, J. W.	Murray, G.	Turner, H. R.
Burton, J. A. H.	Hamilton, T. F.	Neil, J. F.	Tyndall, J. F.
Cattle, J. B.	Harrison, A. J.	Newsome, M.	Wells, W. W.
Codgbrook, A. W. C.	Harrison, H.	Norris, H. C.	Whiteley, G. G.
	Hollington, H. G.	Nuttall, R. H.	Wilkins, P. S.
Coll, F. C. M.	Hornby, T.	Pacey, S. O.	Williamson, W. M.
Copeland, R. W.	Hoyles, L. J.	Pary, S. P.	Willis, F. C.
Corbridge, W.	Hunt, W. D.	Pettigrew, J. C.	Yates, D.
Cowie, R. W.		Philpot, W. C.	

Second Class.

Ambler, F. G.	Cooke, J. W.	Hutchinson, S.	Sawyer, G.
Bates, W. A.	Currie, A.	Jones, E.	Scadding, W. W. H.
Baxter, J. H.	Denham, J.	Keillor, J. D.	Simco, W. A.
Berry, J. H.	Funke, H. F. R.	Kershaw, J.	Smith, T. W.
Bishop, A.	Garbut, W. C.	Murray, S.	Spearman, E. W.
Boulter, E. F.	Gibbs, A.	North, A.	Stanyer, H.
Brown, G.	Gillett, H. E.	Philp, R. J.	Sumner, A. W.
Byrom, J.	Gothard, E.	Quick, A.	Tanner, W. A.
Charlesworth, C. W.	Grey, A. W.	Richford, J. W.	Thomas, R.
	Griffiths, G. D.	Ritchie, H. G.	Wallington, T. H.
Clapham, F. W.	Harper, T.	Rossini, J. L.	Wheeler, P. C.
Clegg, F.	Henshaw, D. M.	Sainter, E.	Whitehurst, A. J.
Cook, R.	Hepburn, J.	Saunders, S. H. M.	Wright, H.

COVENTRY CORPORATION GAS SUPPLY.

The Past Year's Working—The Allocation of the Profits.

At the Meeting of the Coventry Town Council on Tuesday, the report of the Gas Committee for the past financial year, particulars from which were given in the "JOURNAL" last week (p. 662), was presented.

Alderman BOOTH (the Chairman of the Committee), in moving the adoption of the report, dealt at considerable length with the figures submitted. He said the net profit of £6467 was an increase of £2619 compared with the preceding twelve months, and was larger than had ever been realized since the Corporation acquired the gas-works in 1883; and it was chiefly due to the reduction in the price of raw materials. The amount received for gas was only £208 more than before. This would have been increased, however, by £1564 but for the reduction made in the price charged to large consumers last year by the extension of the scale of rebates; and it was satisfactory to find that, notwithstanding the dulness of trade, there had only been a reduction in the consumption of gas supplied through ordinary meters of 811,300 cubic feet, and in money received of £1679. The consumption of gas through prepayment meters had, however, increased by 13,726,300 cubic feet, and the revenue from this extra quantity by £1715. The total receipts were £100,216, or an increase of £2809 over those for the year 1902-3. This was the first time in the history of the undertaking that they had run into six figures. The penny-in-the-slot meters were as popular as ever. The number in use at March 31 last was 4626—an increase of 1368. The quantity of gas made was 639,657,000 cubic feet—an increase over the previous year of 1,067,000 cubic feet, or only 0·16 per cent. The gas sold was, however, 615,604,225 cubic feet, or 13,713,065 cubic feet (2·28 per cent.) more. The gas used on the works had been reduced by 1,896,300 cubic feet, or

from 1·16 to 0·86 per cent. of the make; and the unaccounted-for gas by 10,749,765 cubic feet, or from 4·59 to 2·9 per cent. of the make. With regard to the proposed allocation of the profits, the Committee would have liked to give a larger sum for the relief of the rates, and to reduce the price of the gas to the figure at which it stood before the rise in the price of coal took place a few years ago; but with the sum of £50,000 to wipe off capital, and the large expenditure which had to be incurred at Foleshill for the new works, they could not see their way to do either. One reason for writing off this £50,000 was that when the Foleshill works were completed the Corporation would have come very nearly to the end of their capital powers; and in the course of a few more years they would have to go to Parliament again, and obtain authority to borrow further sums. Then there would be a full inquiry as to how the capital had been spent, and whether obsolete capital sunk in the old works had been properly dealt with. In fact, they must have a clean bill of health in going before a Parliamentary Committee. Parliament had been taking very seriously the large capital expenditure of corporations, and looked with no approving eye on the piling up of municipal debt. This was good reason for the course recommended by the Gas Committee; and upon it he might say they were unanimous.

Mr. JACKSON seconded the motion.

Alderman ANDREWS said he thought the report altogether was a satisfactory one; and so there was little to be said about it. But there was one point to which he wished to draw particular attention. It had been stated that the amount of surplus profit was larger than on any previous occasion, and that this was due to the lower price of raw materials. No doubt this view was correct to a certain extent. But another reason was that the price of gas had been increased 2d. per 1000 cubic feet, which gave an additional profit of £5000; so that a large portion of the profit was owing to this. Of course, this had been diminished to some extent by a reduction in the price of gas to large consumers which took place about nine months ago—the difference to the Committee being about £1500; but this would still leave £3500 net profit, owing to the extra 2d. in the price of gas to other consumers. Personally, he strongly deprecated the reduction in the price of gas to large consumers, as he saw no reason for it. He quite agreed with the proposal to put aside £4000 of the profits to meet the loss of £50,000 which would be caused by discarding the plant at the old works when the gas was made at Foleshill. This money was practically thrown away. The Corporation paid £174,000 for the undertaking, and the portion represented by the manufacturing plant was more than £50,000 of that amount. The true policy of the Committee was the one they had adopted—of gradually wiping out the loss. There was no other way of doing it; and if they put aside £4000 a year, it would take twelve years to reach the £50,000.

The report was adopted.

A SATISFACTORY YEAR AT BURY.

The Bury Town Council, at their Monthly Meeting last Thursday week, had before them the report of the Engineer (Mr. H. SIMMONDS) on the working of the Gas Department for the past year.

The report stated that a profit of £8484 had been made. The net price of gas was 1s. 11d. per 1000 cubic feet for lighting and general purposes, and 1s. 9d. for engines. There was an increase of 25 per cent. in the consumption of gas used by engines—15,845,500 cubic feet, as against 12,713,800 feet in the previous year. For lighting and general purposes, there was a slight falling off in consumption (probably due to the depressed state of trade and to the extensive use of the incandescent burner); the figures being 279,659,100 cubic feet, as against 280,132,200 feet. The prepayment consumption showed an increase of 600,000 cubic feet—16,674,100 feet, against 16,029,400 feet. The Committee last year decided to encourage the use of grillers by offering them to the public free. This had been much appreciated, as shown by the large number fixed during the year. Coke had realized £1000 more than the estimate; while the coal required was purchased at 4d. per ton less than was anticipated, which led to a saving of £600. The gas made during the year was 381,465,000 cubic feet. The amount sold to private consumers was 332,940,050 feet; that used for public lighting, 29,517,070 feet. The loss through leakage, condensation, &c., was 2·6 per cent.

In moving the confirmation of the Gas Committee's minutes, Alderman Fletcher, the Chairman of the Gas Committee, said it was gratifying to know that the undertaking was so successful. Trade had been very bad during the past twelve months; and when the gas-works accounts were made up and came out so satisfactorily, it was a great surprise to both the Committee and the Engineer. However, there was no doubt they were reaping to some extent the fruits of the policy of the Committee during the past few years. By means of a show-room, they had brought gas-fires, cookers, and grillers into much greater use. Other corporations in the immediate neighbourhood had experienced a decreased gas consumption during the past year; while, on the other hand, Bury had had an increase of over 5 million cubic feet as compared with the previous year—notwithstanding the short time in the mills and the economy secured by the use of incandescent burners. Even in Bury there had been a slight falling off in the quantity of gas consumed for lighting; but there had been a large increase in the amount taken for power purposes. The leakage at Bury was the smallest he had seen; being only a little over 2 per cent. During the year, the Committee had completed the erection of a stack of six retorts; and these had contributed in no small degree to the large excess of profit (£4000) over the estimate which the Committee had formed. They had carbonized 111 tons of coal more than in the previous year; but they had received £1000 more for coke. The market for residuals had been good during the year, and had exceeded their expectations. The coal-projector had also been a great saving of labour, and this had helped to improve the results. The Committee estimated that the profits for the coming year would be £5000; and they proposed that the initial price of gas should remain as at present—the only exception being that for prepayment meters the Committee proposed there should be 32 cubic feet instead of 30 feet given for 1d. In this way, the users of prepayment meters would receive a share of the profits just like those who had ordinary meters. To the latter class of consumers there would be 3d. share of profits and 1d. for prompt payment; making together for those who paid promptly 4d. less than the initial price. He questioned whether they could find two corporations who were selling gas at so low a rate. It might be asked why the Committee did not reduce the price further; but he thought under the present circumstances the Council would see the wisdom of keeping the rate as proposed. He thought the ratepayers might feel some satisfaction in knowing that the gas in the coming year would be at the rate of 1s. 10d. per 1000 cubic feet for ordinary consumption, and 1s. 8d. for power. He concluded by remarking that, in accordance with the Act, £4200 of the profits of the past year had been handed over to the relief of the rates; and he expressed his satisfaction at the existence of this clause, as it prevented any quibbling. Whatever profits were made, one-half went to the rates, and the other half to the consumers.

In the course of the subsequent discussion, Alderman Holt drew attention to the fact that while the consumers inside the borough would be paying 1s. 10d. per 1000 cubic feet for their gas, those in the added areas would be charged a net rate of 2s. 7d. Alderman Ashworth was sorry to hear the Chairman say that no one could quibble with the arrangement that one-half of the profits should go to the relief of the rates. There were councillors who remembered a fight some fourteen years ago upon the division of profits, when it took three or four years to come to what they believed was an equitable decision. This was that profit should not be the first consideration, but that the price of gas should be made as low as possible, as it was proved that a large profit could not be made without inequitably affecting the ratepayers. It seemed that eventually they must have another fight; and the question would be whether large profits should be made, and relief given to the ratepayers therefrom, or whether they should revert to the old system, and make the profits of such a character as would just safely keep the Committee from making a loss. Mr. Hewart was of opinion that the consumers were entitled to more consideration—that it was most unfair for their portion of the rates to be raised in this indirect manner. His rates were £50 a year; and he ought not be called upon, through being a large consumer of gas, to contribute towards the rates of those who used a smaller quantity. Dr. Greenhalgh dissented from the proposal that gas should be supplied for motive power at a cheaper rate than for other purposes.

In reply, Alderman Fletcher said that if the added areas would come in and share the responsibility, they would get gas at the same rates as consumers within the borough. As to the profits, the Committee in making their estimates had to study the rise and fall of the markets. They did not want at the end of the year to be in the position of finding they had not got the amount anticipated. Residuals were now easier in price; and if this went on, instead of the £5000 estimated, they might in the current year have a profit of only £2000. Then, again, in six weeks they had had a reduction in consumption of more than 1¼ million cubic feet; and if this continued, they might have a loss of £1000. In looking forward, they must take everything into consideration. With regard to the charge for gas for power purposes, this was reduced so as to encourage consumption during the daytime.

The minutes were confirmed.

PRICE OF GAS FOR POWER AT BURTON.

An interesting discussion took place at last Wednesday's meeting of the Burton-upon-Trent Town Council, when, in accordance with notice, Alderman Lowe moved that gas used by engines within the borough, which was registered by a separate meter, should be charged for at the rate of 2s. 4d. per 1000 cubic feet. He explained that the Committee were opposed to a general reduction in price—in fact, they were opposed to any reduction at all at present, for any purpose, unless it was proved to be absolutely necessary. They had, however, reluctantly come to the conclusion that a reduction for power purposes was essential in the interests of the department. The users of gas-engines formed an important class; and the Committee had noticed of late that there had been a tendency to look about for other sources of power, while in several instances special plant had been laid down for producing power gas. It was in order to meet this competition that the present proposal was made, which would amount to something like a loss of £400 to the department. He had already explained why the Committee were opposed to making a general reduction in price; but, without going over the whole ground again, he would just remind the members of one or two of the reasons. The funds of the department during the last ten years had been depleted in a manner which had not been in the best interests of the concern. They had been drawn upon at a time when the income had been nothing like equal to the amount taken out. In addition to this, they had had to provide for considerable sums overspent on meters, &c., out of revenue, and which the Finance Committee had not been able to provide for them as time went on, owing to the condition of the Money Market. Just now they were experiencing a period of great prosperity in the gas world; but who could say how long it would last? Only the previous week they had settled tar contracts at a price that would involve the Committee in a loss of something like £1000 as compared with last year; and in addition to this, the Committee had various calls upon them. They must take the good with the bad years; and until the liabilities to which he had referred, and others, were cleared off, the Council would be wise to resist a general reduction. It might be urged that they had no right to do all this at the expense of the consumers; but their first duty to the ratepayers was to see that the department was worked on a sound financial basis. After this, they must supply a really good article at a reasonable price; and that he

maintained they were doing so. Their charge did not compare unfavourably with that of towns similarly situated.

An amendment was moved by Mr. Hutchinson, to the effect that all gas used within the borough, except through prepayment meters, should be reduced by 2d. per 1000 cubic feet. He said the charge used to be 2s. 7d.; but in 1901 it went up to 3s. Then they had 3d. taken off; and therefore if the reduction of 2d. now suggested were made, it might be thought that this was bringing the price down to the old figure. Such, however, was not the case. Since that time, the Committee had obtained permission to lower the illuminating power; and thus the consumers were put to the extra expense of adopting incandescent fittings. The Committee said they had depleted funds; but the consumers were not to blame for this, If anybody had been depleted, it was the consumers themselves. The amendment was seconded by Mr. Thornley, who contended that it was not fair for one portion of the community to be called upon to contribute from £5000 to £9000 year after year towards the relief of the rates of the whole of the community. Why should he not have a reduction for the gas used by the stove which cooked his dinner? The people who had gas-engines probably made a profit thereby; but the proposed reduction would not prevent them looking for other sources of power, as the days of gas for this purpose might almost be said to be numbered.

A reduction for lighting purposes was strongly opposed by Mr. King, who pointed out that last year the net profit on the undertaking was under 4 per cent., and that a general reduction of 2d. would do away with the whole of this, while it would not benefit the large number of poor persons who burned gas. Mr. Rowland contended that it was unreasonable to expect the ratepayers to take all the risks and yet to derive no profit as ratepayers from the money invested in the gas undertaking on the security of the general rates. If it could be shown that they were treating the consumers in a less liberal manner than a company would do, then he would think that a strong case had been made out for a reduction. If, however, they were getting as good terms as a company would give them, and then if the consumers, *qua* ratepayers, got back a reduction in their rates of 4d. or 5d. in the pound, he thought they derived a very substantial benefit, He quite agreed that the taking of so large a sum as £7600 per annum from the gas profits for the relief of the rates was not right; and he was glad to see that only £4500 was asked for in the last estimates. This was not an extravagant amount; and he thought that if the policy outlined by the Chairman of the Committee was followed, the finances of the department would be put upon a sound footing, and in course of time the object Mr. Hutchinson had in view might be achieved.

On being put to the meeting, the amendment was lost by 23 votes to 3; and the resolution was then carried.

LINCOLN GAS AND WATER SUPPLY.

Cheaper Gas.

At the Monthly Meeting of the Lincoln City Council last Tuesday, the Gas Committee reported that, in addition to the £2000 already granted towards the rates, they had voted a further £500, and had also decided to reduce the price of gas from 2s. 3d. to 2s. 1d. per 1000 cubic feet from Sept. 29 next. The report of the Engineer and Manager (Mr. J. Carter) showed that 340,230,000 cubic feet of gas were made last year, as against 320,503,000 feet in 1903. This increase was, with one exception, the largest reported; and as it was not due to a severe winter, but was contributed to by every month of the year, it evidenced a general expansion of the Committee's operations. They had made more gas, supplied more consumers, and made more profit than in any previous year. The extensive improvements that had been in progress for several years past in the Bracebridge retort-house, were nearing completion, and had involved an expenditure, spread over several years, of about £3000. The results of this outlay were an increase in the capacity of the house from 850,000 to 1 020,000 cubic feet per day, and an annual saving of £900 by improved working results. Alderman Wallis (Chairman of the Gas Committee) mentioned that the reduction in price would be equivalent to a return to the consumers of £2500 a year. There had been one or two applications for a reduction in price to large consumers; and he thought this was not unreasonable. Another year the Committee hoped to deal with the matter. Alderman Wyatt, as a ratepayer and consumer, expressed his satisfaction at the year's working; and Mr. Pennell voiced the Finance Committee's gratitude at the splendid manner in which the Gas Committee had helped the rates during the year. The sum they had handed over represented 4d. in the pound.

The Water Engineer (Mr. J. H. Teague), in his report, stated that the operations of the department during the past year had been exceptional in all branches; and considerable extensions and new works had been carried out. There was a profit of £7926. From this, £3304 had been paid in redemption of debt, and £2831 for interest; leaving a net profit of £1791, added to which was £6161 brought forward from last year. From this the Committee voted £1832 for extensions of mains, and £750 as a grant to the rates; leaving £5370 to carry forward.

INCANDESCENT GAS LIGHTING FOR SOUTHWARK.

At the Meeting of the Southwark Borough Council on Wednesday, a report was considered from the Borough Engineer (Mr. A. Harrison, M.Inst.C.E.) to the effect that at present there are 1035 flat-flame burners in the side streets, for which an annual charge is made by the South Metropolitan Gas Company of £3 3s. 9d. each; the light being 14-candle power. If these were converted into incandescent gas-lamps fitted with No. 4 burners, they would produce approximately 60-candle power lighting. To get the greatest benefit in this direction, it would be necessary to provide a new class of lantern, the cost of which would be £2; and the annual cost of maintenance afterwards would be £3 6s. each per annum. The total cost of conversion would be £1800. This amount the Gas Company would allow to be spread over five years. For this period there would therefore be an increased charge of 9s. 1d. per lamp, to be afterwards reduced to 2s. 3d. per lamp per annum. For this comparatively trifling sum they would get more than four times the quantity of light they now had. Mr. Attenborough said he hoped the ratepayers would bear in mind that now, two years and eight months after the Moderates had first fought for the incandescent gas lighting of the side streets, the Progressives had been forced to adopt the views originally put forward. A motion that the Gas Company's offer be accepted was carried unanimously.

PRICE OF ILLUMINANTS IN GERMAN TOWNS.

In a recent number of the "Journal für Gasbeleuchtung," some statistical particulars were given in regard to the cost and selling price of various illuminating materials in 143 small towns in Germany in which the number of inhabitants ranges from 1800 to 5000. They were compiled by Herren Barth, Kautny, and Knappich; and we reproduce them in the following tables:—

Illuminating Power and Consumption per Hour.

Illuminant.	Illuminating Power in Hefner Units.*	Consumption per Hour.	Consumption per Hefner Unit.
Coal gas—			
Flat-flame burner	16	160 litres †	10·00 litres
Argand ,,	32	250 ,,	7·80 ,,
Incandescent ,,	72	120 ,,	1·70 ,,
"Millennium" burner	1400	1200 ,,	0·85 ,,
Acetylene—			
Ordinary burner	50	30 ,,	0·60 ,,
Incandescent ,,	60	15 ,,	0·25 ,,
Petroleum—			
Round burner	30	0·08 kilo.	2·70 grammes
Kitson ,,	900	0·33 ,,	0·37 ,,
Alcohol—			
Incandescent burner	50	0·10 ,,	2·00 ,,
Electricity—			
Arc lamp	500	375 watts	0·75 watts
Bremer lamp	1000	400-600 ,,	0·4—0·6 ,,
Liliput ,,	130	160 ,,	1·23 ,,
Nernst ,,	180	218 ,,	1·21 ,,
Incandescent lamp	16	55 ,,	3·44 ,,

* 1 Hefner unit = 0·877 English candle. † 100 litres = 3·53 cubic feet.

Particulars of Cost.

Illuminant.	Unit Price.	Cost per Hour.	Cost per 10 Hefner Units.
		Centimes.	Centimes.
Coal gas—			
Flat-flame burner	20 c. per cub. met.*	3·20	2·00
Argand ,,	,, ,,	5 00	1·56
Incandescent ,,	,, ,,	2·40	0·34
"Millennium" burner	,, ,,	24 + 4·3	0·15 + 0·3
Acetylene—			
Ordinary burner	1 fr. 56·25 c. ,,	4·70	0·94
Incandescent ,,	,, ,,	2·35	0·39
Petroleum—			
Round burner	34·25 c. per kilo.	2·50	0 84
Kitson ,,	,, ,,	10 31	0·115
Alcohol—			
Incandescent burner	50 c. ,,	5·00	1·00
Electricity—			
Arc lamp	75 c. per K. W. H.	28 10	0·56
Bremer ,,	,, ,,	30—35	0·3—0·45
Liliput ,,	,, ,,	12·00	0·92
Nernst ,,	,, ,,	16·35	0·91
Incandescent lamp	,, ,,	4·10	2·57

* 1 c. per cubic metre = 2·7d. per 1000 cubic feet.

Selling Price in Centimes per Cubic Metre.

—	Gas Used for Lighting.		Gas Used for Cooking and Power.	
	Max.	Min.	Max.	Min.
9 towns of 1800 to 2500 inhab.	27·50	18·75	20·00	15·00
14 ,, 2501 ,, 3000 ,,	27·50	20·00	22·50	12·50
22 ,, 3001 ,, 3500 ,,	31·25	20·60	1 at 31·25 20 ,, 22·50	15·00
31 ,, 3501 ,, 4000 ,,	1 at 37·50 30 ,, 32·50	18·75	1 ,, 31·25 30 ,, 25·00	10·00
25 ,, 4001 ,, 4500 ,,	1 ,, 37·50 24 ,, 32·55	20·00	25·00	12·50
42 ,, 4501 ,, 5000 ,,	1 ,, 37·50 41 ,, 32·50	20·00	1 at 31·25 41 ,, 25·00	15·00

By way of comparison, the price per cubic metre of acetylene in 43 towns is given, on the authority of Professor Vogel. It ranges from 1 fr. 25 c. to 3 frs. 12·5 c.; the average being 2 frs. 37·5 c.

The Burslem Town Council have resolved to apply to the Local Government Board for sanction to borrow £6500 to cover the cost of new purifying plant for the gas-works, and for the purchase of a site.

SALES OF STOCKS AND SHARES.

At the Mart, Tokenhouse Yard, E.C., last Tuesday, Mr. Alfred Richards sold, by order of the Directors, a new issue of £12,000 of 4 per cent. perpetual debenture stock of the Hastings and St. Leonards Gas Company (being part of the stock authorized by their Act of 1899) at from £100 10s. to £103 per £100 of stock. On the same occasion, he disposed of some fully-paid £10 new ordinary shares, carrying 5 per cent. dividend, in the Southend Water Company, at from £10 10s. to £10 12s. 6d. each. Some "D" capital water stock of the Barnet District Gas and Water Company (last dividend £5 5s. per cent. per annum) fetched from £109 to £112 10s. per £100 of stock. A new issue of £5000 of 5 per cent. ordinary stock of the South Essex Water Company (dividend on similar stock 4 per cent.) was disposed of at from £101 to £101 10s. per £100 of stock, *cum div.* as from the 1st prox. A small parcel of ordinary "C" stock of the Ilford Gas Company, ranking for a standard dividend of 5 per cent., subject to the sliding-scale, but carrying one at the rate of 6 per cent., was put up in £100 lots, which were all sold at £17 premium. A few fully-paid £10 shares, ranking for a maximum dividend of 10 per cent. (the last being at the rate of 8 per cent.), fetched £20 apiece. Some fully-paid £10 shares in the Barking Gas Company, carrying a dividend at the rate of 7 per cent. per annum, were sold at from £13 to £13 5s. each. The last item in the particulars of sale was some consolidated ordinary stock of the West Ham Gas Company, carrying 5 per cent. dividend, which fetched from £100 to £102 per £100 of stock. With reference to the recent sale of three fully-paid £50 shares in the Warwick Gas Company mentioned last week, it should have been stated that the price realized was £153 each.

ELECTRICITY SUPPLY AT BOLTON.

At the Meeting of the Bolton Town Council last Wednesday—the Mayor (Mr. J. Heywood) in the chair—the presentation of the minutes of the Electricity Committee afforded the Chairman (Dr. Panton) an opportunity of referring to the work during the past financial year, some features of which, as revealed by the accounts, are noticed in our "Electric Lighting Memoranda."

Dr. PANTON said the accounts put before the Council were for the ninth complete year of trading; and he was happy to say the output was again largely increased. In the year 1902-3 the total was 3,802,597 units; while this year it was 5,056,898 units—an increase of 1,254,301 units. The sale of this current brought in the sum of £37,285, which was an increase of £5228 on the previous year. The gross revenue was £39,309. The cost of generating the current came to £14,914; and deducting this from the gross revenue, the gross profit was £24,395, which was a rise of £3588. The increase in gross profit was not quite so much as the increase in the revenue; but this was because they lowered their price very considerably. Interest took up £6047, and the depreciation they placed at the large sum of £10,868. Taking this away from the gross profit, they had a net profit on the year's working of £7480. Last year they carried forward a balance of £1324, which made the surplus £8804. Out of this, it was proposed to pay £6818 in relief of the rates; and they would have in hand for future use a sum of £1988. The cost of production had again been very considerably reduced. This year the figure was 0·707d. per unit; or if they allowed for all capital charges, it represented 1·51d. for every unit sold. Every item in the cost had been reduced—coal, oil, waste, water, and repairs. The capital expenditure to March 31, 1903, was £207,482, and during the past year there had been spent on capital account £34,319. For this they had enlarged the boiler and engine house and installed a 1500 horse-power engine and generator, besides providing additional mains, meters, and motors. With this £34,319 the capital expenditure was carried up to £241,801. They had written off in depreciation £41,299; leaving the net capital £200,502. For every £100 of capital expended, they had now a debt of only £83. Since the Committee commenced, the total amount paid in relief of the rates had been £18,026. In the early days, there were losses of £1939; so that the Electricity Department had actually paid in relief of rates £16,087. In the year ended March 31, 1898, the Gas Department reached the high-water mark, and handed over £26,466. This was, undoubtedly, a magnificent sum. In the present year, however, the department had furnished £20,000, and the Electricity Department £6818; so that combinedly the rates were benefiting on this occasion by the maximum amount. This was a matter of record; and if the Council adopted the Committee's recommendation, the lighting consumers would get a slight concession, there would also be one for motor driving, and there was the abolition of meter-rents for lighting, in so far that one meter would be free from rental. The finances were in a healthy condition; for, over and above the sinking fund, they had a total of £10,964.

Alderman LORD asked why no concession had been made to the flat-rate consumers of electricity. He moved, as an amendment, that the following paragraph in the minutes be referred back to the Committee: "Subject to the requisite consent being obtained from the Board of Trade, the charge for electric current for tramway purposes be, as and from the 1st of April last, at a rate of 1·10d. per unit. Application to be made to the Board of Trade for permission to charge at a price lower than 1·25d. per unit for the current supplied for tramway purposes." Electricity, he pointed out, was being supplied to ordinary consumers at little more than 3½d. per unit, and to the Tramways Committee at, he believed, 1¼d. per unit; and now it was proposed that it should go down to 1·10d. per unit. He believed in every undertaking of the Corporation standing upon its own bottom. A manufacturer had no right, because his works were not doing well, to claim free water from the Corporation; nor had the Tramways Committee the right to demand electricity below cost price. He contended that this was not a sound business principle.

Mr. W. COOPER seconded the amendment.

Mr. WADDINGTON pointed out that the Tramways Department was the largest consumer of the Electricity Department. Out of £37,000, the Tramways Committee found about £17,000.

Alderman W. H. BROWN said it was an entirely wrong business principle that, because the Tramways Department was the largest consumer of electricity, it ought to be allowed to have the current at cost price. They ought not, as a Corporation, to sell anything at less than cost price; and if the Tramways Committee had to be propped up by concessions from other Committees, the sooner the matter was altered the better. The Tramways Committee should pay their own way.

Alderman MILES congratulated the Electricity Department upon its wonderful progress, and asked the Council to refrain from interfering with this progress, as they would do if the amendment were adopted. The Tramways Committee were the largest consumers of electricity; and he believed it would be found that the price now proposed to be charged for current was under cost.

Mr. PANTON hoped the Council would reject the amendment. He reminded Alderman Lord that twelve months ago the flat-rate consumers' price was lowered from 5d. to 4d. The long-hour consumers, which were then and now upon the maximum-demand principle of 6d. for the first hour and 3d. for subsequent hours, felt that no concession was made to them. The Committee were now anxious to make such concession, believing that it was justified. By the charge proposed, upon the capital involved, they would still make a profit of 2½ per cent. The Electricity Department had the largest percentage of profit of any department of the Corporation.

The amendment was lost by 17 to 42, and the minutes were passed.

METROPOLITAN WATER BOARD.

A Meeting of the Board was held on Friday, at the offices of the Metropolitan Asylums Board, under the presidency of Mr. R. M. Beachcroft. The *agenda* contained a number of reports from various Committees, and, in accordance with their recommendations, the Works Committee were authorized, until further orders, to give the respective Chief Engineers of the Water Companies the same authority as is conferred upon them at present by their Boards of Directors, subject to such variation as may, under the altered circumstances, be necessary, and subject to the condition that coal and stores are only ordered with the sanction of the Committee, to be given on requisitions to be submitted in advance by the Engineers. The Committee had had under consideration the steps to be taken by the Board in connection with the chemical and bacteriological examinations of water. At present the water supplied by all the Companies, with the exception of the Kent Company, is subjected to a daily examination by Sir W. Crookes and Professor Dewar; the water of the Kent Company being analyzed by Professor Percy F. Frankland. The Committee expressed the opinion that, pending a thorough investigation into the system of examination ultimately to be established by the Board, it would be very undesirable to cause any interruption in the work carried on by these gentlemen; and it was proposed that the existing arrangements should be continued. This was agreed to. The General Purposes Committee recommended that the policy of the Board in organizing the business should be to concentrate it at the central offices, and that each of the Companies' present chief offices should be a district office under the supervision of the Clerk of the Board, so far as matters of administration and general business are concerned, and of the Accountant of the Board so far as relates to matters of finance. This course was approved.

GRAND JUNCTION WATER-WORKS COMPANY.

The Half-Yearly General Assembly of the proprietors in this Company was held at the Offices, South Molton Street, on Wednesday last—Mr. FREDERICK TENDRON, F.G.S., presiding.

The SECRETARY (Mr. J. Goodwin) having read the notice calling the meeting, the report and accounts for the six months ending the 31st of March last were presented. They showed that, after providing for all liabilities, and for the dividends recommended, which were at the rates of £12, £9 10s., and £7 13s. 4d. per cent. per annum, there was a balance of £7264 of undivided profit.

The CHAIRMAN remarked that the proprietors had doubtless noticed the absence of Mr. Stoneham's signature to the accounts. His explanation was that he objected to the item in the balance-sheet of "Staines reservoirs—amount advanced out of profits," £58,654. Mr. Stoneham's idea was that this was kept as a dormant claim against the Water Board; and, in his position as trustee for the public, he left the protection of the Company's interests entirely to the latter's Auditors. The Directors really had not time to convince him that this was no dormant claim; they had never dreamt of claiming the amount from the Water Board. It was included in the award that had been given to the Company; but as the Directors made it part of the Company's claim, and had no reason to suppose that the Arbitrators did not entertain the claim, and in the award include the amount asked for, they could not strike the item out of their assets. The Company's progress had continued. They had earned in the past half year the largest rate of dividend, he supposed, which they had ever earned; it had been a steady and progressive rate for the last nine years. It reached for the past six months the rate of 10·43 per cent. on the maximum "A" and "B" shares. In this amount of earnings he made no reference to the payment of a little over £7000 for interest which they were advancing—or practically regarded as having advanced—on behalf of the Water Board in connection with Staines; and the Directors concluded that this was repaid to the Company in the amount of the award. As in the year of the frost, 1895, the "D" and "C" shareholders received a smaller dividend than they were entitled to, and the "A" and "B" shareholders received less than they had been

accustomed to, the Directors had thought it was only right to take the fact into consideration in the dividends they were now proposing. To make up for this deficiency, £11,000 was taken from the balance; and the amount carried forward to next account was £7264, to which would have to be added the profit they might make between March 31 last and midnight on the 23rd inst.; the latter being the date, they were told, when the Water Board would come into possession. The Directors took care to retain for the Company, as they had the full right to do, the whole balance standing to the credit of the profit and loss, and it was paid into a separate account. As the Court of Arbitration had not yet fixed the amount to be allowed to the Company for liquidation expenses, the Directors had transferred £8000 to the credit of a separate account for this purpose. They were certainly not going to the Water Board to ask them for permission to spend money or to pay the liabilities which the Company might contract in this connection. He had no doubt, however, that an amicable arrangement would be arrived at with the Water Board, from whom and from their principal officers the Directors could not have received more courtesy than had been extended to them. He now came to a very important point, as to which he felt that they had been rather hardly treated. He was absolutely satisfied with the award of £3,500,000; but he was not at all satisfied with having £200,000 of the amount knocked off for sinking fund. The Companies in the matter of the sinking fund were not appealing to the House of Lords on moral grounds—for moral grounds were not listened to—but on the question of the law of the land. Although he had not the slightest doubt that the Water Act never for a moment intended to free the Companies from the Chamberlain of London clause, he was not at all sure that the law of the land would not say that Mr. Balfour Browne's contention was the right one—namely, that the value of an undertaking was its net earning divisible power. The Chamberlain of London was simply in the position of a shareholder in connection with the sinking fund—a shareholder of the Water Companies in trust for the people of London. If the law of the land was in accordance with the contention of Mr. Balfour Browne, the House of Lords would give it as the law. When once the decision was given, the Directors would issue to the shareholders the formal scheme for the appropriation of the money; and schedule 4 of the Water Act contained full provision for protecting each class of shareholders if they thought the Directors' scheme was not absolutely equitable between the different classes. As far as their judgment went, the Directors would hold the scales absolutely even in the different classes, and he did not hesitate to say that it would be wise of every class to accept the conclusion at which the Directors arrived. It must be remembered that there were pitfalls for each class, and although they were assuming a 30 years' purchase, they could not forget the powerful argument of Mr. Fletcher Moulton that they were only entitled to 25 years' purchase. They claimed to be purchased on the basis of 10 per cent. with some prospective profit; but the whole thing teemed with uncertainty as to the number of years, and no information could be obtained from the Court of Arbitration as to how the latter arrived at their decision. Another point in the schedule was the right given to the Directors to compensate officers and others for special services rendered to the Company, and to take into consideration those who would not receive compensation under the Water Act. This matter was to be dealt with in a separate resolution, to which the shareholders' attention had been specially called by the Directors when issuing their report; and the shareholders were asked to send their proxies to the Directors if they approved of the resolution. A large number of proxies, it was very gratifying to know, had been received in favour of the resolution—chiefly, as usual, from the large shareholders, who were most affected. He concluded by moving the adoption of the report and accounts.

Mr. Henry Mott seconded the motion, which was carried unanimously.

The Chairman afterwards proposed the payment of the following dividends for the last financial half year: At the rate of 12 per cent. per annum on the £50 "A" and £25 "B" shares, 9½ per cent. on the £25 "C" shares, and £7 13s. 4d. per cent. on the £50 "D" shares.

The Right Hon. Viscount Knutsford, G.C.M.G., seconded the resolution, which was carried unanimously. His Lordship afterwards proposed the re-election of the retiring Directors, Mr. Charles Horsley, Mr. Francis Tagart, Mr. Tendron, and Mr. E. A. Goulding, M.P.

Mr. Mott formally seconded the motion, which was carried unanimously.

The Chairman then proposed the election as a Director of Mr. James F. Remnant, M.P., in the room of Mr. William Harrison, deceased.

The Right Hon. Sir J. C. R. Colomb, K.C.M.G., M.P., seconded the resolution, which was supported by Mr. E. A. Goulding, M.P., and carried unanimously.

Mr. Robert A. M'Lean and Mr. C. P. Crookenden were afterwards elected Auditors "for the purpose of discharging the duties which, under the Metropolis Water Act, 1902, remain to be discharged by the Auditors of the Company; their remuneration to be at the rate of £84 and £42 per annum respectively, and their office to be determined so soon as such duties are completed."

The Chairman subsequently proposed a resolution authorizing the Directors "to retain, out of the compensation moneys awarded to the Company, the sum of £12,000, to be distributed by the Directors among the officers, clerks, and others who have rendered special services to the Company, in such proportions and amounts as the Directors shall think proper." He stated that he did not like the idea of a number of their superior officers, clerks, and workpeople being passed over to the Water Board, like so many chattels, without some expression of goodwill and kindly feeling towards them both from the Directors and the shareholders. Many of the officers had served the Company for a quarter-of-a-century. The sum mentioned in the resolution had been arrived at after careful consideration on the part of the Directors. He afterwards referred in very warm terms to the services, in particular, of Mr. Goodwin (the Secretary), who had been connected with the Company for nearly forty years; of Mr. Walter Hunter, M.Inst.C.E. (the Engineering Director); and of Mr. Bonnor-Maurice, who had been their Solicitor for nearly a quarter-of-a-century, and who had most skilfully conducted their legal proceedings.

Mr. Francis Tagart seconded the motion, which was carried unanimously.

Mr. Hunter and the Secretary expressed their acknowledgments.

Mr. A. H. Baker then proposed a resolution authorizing the application out of the Company's funds of the sum of £5000, "to be distributed by the Directors among themselves in such proportions as they may elect, in recognition of their special services rendered to the Company." The Directors had, he remarked, been connected with the Company's affairs for many years, and had carefully watched over and conserved their interests during a very trying and anxious time. They had had to defend the Company's position before two Royal Commissions, and to oppose many confiscatory Bills introduced into Parliament by the London County Council, and, finally, they had come out of the recent arbitration fairly well on the whole. The Directors had, in fact, proved themselves able champions of the best interests of the Company.

The Rev. G. N. Meyrick-Jones seconded the motion, which was carried unanimously.

The Chairman, in reply, observed that it was a great satisfaction to the Directors to have had their services so cordially recognized by the mover and seconder of the resolution, and by the shareholders generally.

The proceedings then terminated.

SHEFFIELD CORPORATION WATER SUPPLY.

Report of the General Manager.

The report of Mr. W. Terrey, the General Manager of the Sheffield Corporation Water Department, with the accounts for the year ended the 25th of March, was presented to the Water Committee at their meeting on the 1st inst. The capital expenditure in connection with the completed works up to March 25, 1903, less the capitalized cost of raising stock, was £2,354,253; and there was laid out for extensions and machinery during the period covered by the accounts a sum of £23,453—making together £2,377,707. On the Little Don Valley works there has been a total expenditure of £727,479; and on the Rivelin Tunnel works £28,647. The total capital expenditure to the close of the financial year was therefore £3,133,833. The total revenue was £145,069, or £4851 more than in the preceding year; and the expenditure was £31,269, or £1109 more. The net revenue was £113,799. Deducting therefrom the annuities, interest on Corporation stock and mortgages, &c., £84,119, left a net profit of £29,680, or £3660 more than in the year 1902-3. Subtracting the payment to the sinking fund, £10,773, there was left a surplus of £18,907, or an increase of £3105 compared with the preceding year. The total amount provided from the revenue account and appropriated to the sinking fund up to the 25th of March last, with the earnings thereon, amounts to £144,312. Since the acquisition of the undertaking by the Corporation on Jan. 1, 1888, the accumulated surplus, after discharging all liabilities, including the sinking fund, amounts to £120,825. The additional number of houses supplied last year was 2106, bringing up the total to 96,872; and of domestic and trade supplies 8174, making 157,239. The total length of new mains laid was 10 miles 1689 yards; bringing up the entire length of pipes to 432 miles.

The total quantity of water delivered from the works of the Corporation during the year, including the statutory compensation water passed into the Rivers Loxley, Rivelin, and Don, was 7,291,005,607 gallons, or 32,549,132 tons. The following table shows the average daily quantities of water supplied for trade and domestic purposes, and the average rates per day per head of the population:—

	Total for the Year.	Average Daily Supply.	Average Rate per Head Daily.
Trade purposes by meter	1,434,794,530	3,920,204	8·69
Supplies in bulk to local authorities by meter	548,302,000	1,498,093	3·32
Total by meter	1,983,096,530	5,418,297	12·01
Domestic and other supplies, including water for fire extinction	1,973,108,404	5,391,006	11·95
Total for all purposes	3,956,204,934	10,809,303	23·96
Totals for 1902-3	3,988,949,074	10,928,628	24·77

Notwithstanding a considerable increase in the sale of water for trade and other purposes by meter, the average daily quantity supplied for all purposes was lower last year than in the preceding twelve months. This satisfactory result is attributed to the operation of two causes—viz., the prevalence of cold and wet weather during the summer months, and the increased vigilance in inspection for the detection and prevention of waste.

Mr. Terrey concluded his report with a detailed account of the present state of the works under his supervision.

At a Meeting of the City Council last Wednesday, the report above referred to came up with the Water Committee's minutes. Alderman Gainsford (the Chairman of the Committee), in moving the adoption of the latter, said it was rather extraordinary that in a year when the trade of the city had certainly not been good, the water accounts had been able to show so large a profit as £18,000—an increased profit compared with the preceding year. It would be of some interest to show how this came about. In the first place, though the building of new house property in the city had to a large extent ceased in the past year or two, it could be ascertained that the houses which had been put up during the boom in building were to a very large extent coming for the first time into charge for water-rates. There were 2106 more houses in respect of which water-rate had been paid during the year under review than in the previous twelve months; there were 998 more

baths paid for; and though the building of new houses had very much diminished, the increase of revenue from the domestic supply was shown in the accounts to be no less than £3476. A second cause was that they had been able to supply so many houses with all they required, though the Committee had not had the use of Langsett. A further fact to be considered was that because of the wet season they had been able to make a liberal sale of water to Rotherham and Doncaster. From these outside authorities, Sheffield had derived a revenue of £12,498. Another cause of the augmented receipts was the increase from meter supply. This looked rather odd in view of bad trade. But the engineers in the city were becoming more and more alive to the fact of the excellence and economy of Corporation water for their purposes, though the first cost might be more. Another source of additional revenue was that the water, being excellent for the brewing of beer, was being used in increasing quantities for this purpose. The Council had come to an end of the period when they could show large balances on the water undertaking. There was an accumulated balance of £120,000. It was certain that before this time next year the Langsett reservoir would be brought into use, and they would cease charging interest and sinking fund to revenue. The reserve of £120,000 would then have to be drawn upon. It was inevitable that in future years there should be large deficits on the water accounts. At the same time there was no cause for alarm. He believed the city had a very sound source of revenue in the water undertaking; and even if these times should come, they would be able to pull round. During the past 14 or 15 years, there had been saved to the public of Sheffield no less than £374,304, according to the water accounts, which sum would otherwise have gone into the pockets of private shareholders. Though there was ample cause for care and watchfulness in the future, there was no need for anxiety. Owing to the immense extension of the city, the concern had done well. For the next few years it would have a time of reverse to a certain extent. But it was sound in finance as well as in works; and it was incapable of being affected by caprices of fashion or the inventions of genius. The minutes were passed.

THE NEW RESERVOIR FOR NEW YORK.

In the "JOURNAL" a fortnight ago, reference was made to the additional storage reservoir which is in course of construction for the supply of New York. It is situated in Jerome Park in the northern portion of the borough of the Bronx; and when completed it will be one of the largest reservoirs in the world. It was commenced about nine years ago, and it should have been finished and ready for use by the end of 1902; but, as already explained, the progress of the work has been interfered with in various ways. It is hoped, however, to have one of the two basins into which it is divided in operation by the close of the present year, and the other by December, 1905. The following particulars, which were published in a recent number of the "Engineering Record," will give an idea of the proportions of the reservoir.

The extreme length of the reservoir is 5800 feet, and its greatest width 2650 feet, measured at the top of the embankment. Its capacity will be between 1900 and 2000 million gallons; and the area of the water will be 241 acres. The average depth of water below the full reservoir level, which is to be at an elevation of 131 ft. 6 in. above city datum, will be about 25 feet. A division wall 4200 feet long divides the reservoir into an eastern and a western basin; the former having an area at full reservoir level of 147 acres and a capacity of 1,174,650,000 gallons, and the latter an area of 94 acres and a capacity of 770,600,000 gallons. By far the greater part of the reservoir is in excavation for the whole or part of its depth; only about 1½ acres of the site having been at such an elevation as to require no digging other than the removal of soft top soil. The maximum cut was 65 feet deep, and the average cut approximately 18 ft. 6 in. The perimeter of the reservoir is made up of 5000 feet of retaining or breast wall and 9900 feet of embankment with a rubble masonry core wall and concrete slope paving; making the total length round the reservoir about 2 miles 1400 yards. There are seven gatehouses connected with the reservoir. No. 1 is situated nearly a mile to the north of the north end, at the point where connection is to be made to the new Croton aqueduct. From this gatehouse a short aqueduct will lead to the reservoir. No. 5 is situated near the centre of the reservoir, and is the central controlling station at which the flow of the water from and into the aqueducts and reservoir can be directed in a variety of ways. The other gatehouses, at several points around the reservoir, control the flow of water into the pipes which will supply different sections of the city, as well as, in one or two instances, additional connections with the aqueduct. The division wall contains the aqueduct connections from the old and new Croton aqueducts to the main gate chamber, situated near the middle of the reservoir, the inlet conduits from this chamber to each basin, and a continuation of the old aqueduct towards the city proper. The principal total quantities involved in the construction of the reservoir are estimated to be approximately as follows: Earth excavation, 4,060,000 cubic yards; rock excavation, 3,000,000 cubic yards; rubble masonry, used principally in the core walls of the embankments, the division wall between the two basins and in the foundations of the gatehouses and other structures, 297,000 cubic yards; portland cement concrete, to be used for paving the 216 acres of the bottoms of the two basins, for paving the slopes of the embankments, and for portions of the aqueducts and other structures, 225,000 cubic yards; cut granite masonry, in the copings of the walls and in the gate chambers and other structures, not including the superstructures, 6500 cubic yards; and cast-iron pipes for connections to the distribution system and for drains, from 48-inch to 6-inch, requiring 3870 tons of pipe and special castings. The contractors' tender on the basis of the preliminary quantities was $5,473,060; but it is now estimated that the total cost of the reservoir will be nearly $7,000,000.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 781.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.	GAS COMPANIES.			£ s. d.
590,000	10	Apl. 14	10½	Alliance & Dublin 10 p.c.	20–21	..	5 0 0
100,000	10	"	7½	Do. 7 p.c.	13–14	..	5 7 2
200,000	5	May 12	6½	Bombay, Ltd.	6–6½	..	5 4 0
140,000	5	"	6½	Do. New, £4 paid	4⅝–5⅛	..	4 18 11
380,000	Stk.	Feb. 25	12	Brentford Consolidated	242–247	..	4 17 2
300,000	"	"	9	Do. New	182–187	..	4 16 3
50,000	"	"	5	Do. 5 p.c. Pref.	127–132	..	3 15 9
206,250	"	June 10	4	Do. 4 p.c. Deb.	102–105*	..	3 16 2
220,000	Stk.	Mar. 10	10⅝	Brighton & Hove Orig.	212–217	..	4 19 1
246,320	"	"	7½	Do. A. Ord. Stk.	150–155	..	5 0 0
460,000	20	Apl. 14	10	British	38½–39½	..	5 1 3
100,000	Stk.	Feb. 25	6	Bromley, Ord. 5 p.c.	116–120	+2	5 0 0
165,700	"	"	4½	Do. do. 3½ p.c.	89–93	+1½	4 16 9
500,000	10	May 12	7	Buenos Ayres (New) Ltd	10¾–11¼	..	6 4 5
250,000	Stk.	Dec. 30	4	Do. 4 p.c. Deb.	94–96	..	4 3 4
150,000	20	Mar. 10	8½	Cagliari, Ltd.	21–23	..	7 3 6
100,000	10	May 27	10	Cape Town & Dis., Ltd.	14–15	..	6 13 4
50,000	50	May 3	6	Do. 6 p.c. 1st Mort.	51–53	..	5 13 2
1,375,000	Stk.	Feb. 25	5⅝	Commercial 4 p.c. Stk.	110–114	..	4 11 3
536,485	"	"	5	Do. 3½ p.c. do.	106–109	..	4 11 9
442,947	"	June 10	3	Do. 3 p.c. Deb. do.	85–87*	+½	3 9 0
800,000	Stk.	June 10	7	Continental Union, Ltd.	114–118*	+1½	5 18 8
200,000	"	"	7	Do. 7 p.c. Pref.	140–145*	+3½	4 16 7
575,000	Stk.	Feb. 25	5½	Crystal Palace Ord. 5 p.c.	118–123	..	4 6 8
60,000	"	"	5	Do. 5 p.c. Pref.	120–125	..	4 0 0
112,533	"	Jan. 14	5	Do. 5 p.c. Deb. Stk.	136–139	+1	3 11 11
486,090	10	Jan. 28	11†	European, Ltd.	18½–19½	..	5 12 10
354,060	10	"	11†	Do. £7 10s. paid	13½–14½	..	5 13 10
15,243,200	Stk.	Feb. 11	4⅛	Gas-light and Coke — 4 p.c. Ord.	91–93	−3	4 14 7
2,600,000	"	"	3½	3½ p.c. max.	89–91	..	3 16 11
3,799,735	"	"	4	4 p.c. Con. Pref.	108–111	..	3 12 1
4,193,975	"	Dec. 11	3	3 p.c. Con. Deb.	88–90	+1	3 6 8
258,740	Stk.	Mar. 10	5	Hastings & St. L. 3½ p.c.	90–95	..	5 5 3
70,000	10	Apl. 28	11	Hongkong & China, Ltd.	15–16	..	6 17 6
3,800,000	Stk.	May 12	10	Imperial Continental	202–205	..	4 17 7
473,600	Stk.	Feb. 11	3½	Do. 3½ p.c. Deb. Red.	97–99	..	3 10 8
165,242	Stk.	Mar. 10	6	Lea Bridge Ord. 5 p.c.	113–118	..	5 1 8
561,000	Stk.	Feb. 25	10	Liverpool United A	215–216	..	4 12 7
718,100	"	"	7	Do. do. B	159–161	..	4 6 11
306,083	"	Dec. 30	4	Do. do. Deb. Stk.	108–110	..	3 12 9
75,000	5	Dec. 11	5	Malta & Medn., Ltd.	4¼–4¾	..	5 5 3
560,000	100	Apl. 5	5	Met. of 5 p.c. Deb.	100–103	..	4 17 1
250,000	100	"	4½	Melbourne 4½ p.c. Deb.	100–102	..	4 8 3
541,920	20	May 27	3½	Monte Video, Ltd.	9–10	..	7 0 0
1,515,892	Stk.	Feb. 26	4½	Newc'tle & G'tesh'd Con.	103¼–104½	..	4 6 2
406,025	Stk.	Dec. 31	3½	Do. 3½ p.c. Deb.	93½–94½	..	3 14 1
300,000	Stk.	May 12	8	Oriental, Ltd.	138–143	+3	5 11 11
600,000	5	Mar. 29	7	Ottoman, Ltd.	5⅜–6⅜	..	5 12 0
					* Ex div.		
£			p.c.	GAS COMPANIES.			£ s. d.
235,005	Stk.	—	6½	Ply'mth & St'house 5 p.c	—	..	—
851,070	10	Apl. 28	7	River Plate Ord.	10⅜–11⅛	..	6 4 5
300,000	Stk.	Dec. 30	4	Do. 4 p.c. Deb.	95–97	..	4 2 5
250,000	10	Mar. 29	7	San Paulo, Ltd.	10½–11½	−½	£ 1 9
135,000	Stk.	Mar. 10	10	Sheffield A	237–259	..	4 3 8
209,984	"	"	10	Do. B	236–238	..	4 4 0
523,498	"	"	10	Do. C	235–237	..	4 4 0
116,106	Stk.	Mar. 29	5	Shrewsbury Ord. 5 p.c.	107–110	..	4 10 11
6,150,000	Stk.	Feb. 11	5½	South Met., 4 p.c. Ord.	125–127	−1	4 3 11
1,832,700	"	Jan. 14	3	Do. 3 p.c. Deb.	89–91	+2	3 5 11
380,940	Stk.	May 12	5	Southampton Ord.	105–110	..	4 10 11
87,950	"	—	4	Do. 4 p.c. Deb.	—	..	—
120,000	Stk.	Feb. 25	6	Tottenham and Edmonton — A. 5 p.c. B. 3½ p.c.	122–125	..	4 16 0
313,020	"	"	4½		97–102	..	4 8 3
182,380	10	June 10	8	Tuscan, Ltd.	£⅛–8⅜*	..	9 2 10
149,900	10	Jan. 2	5	Do. 5 p.c. Deb. Red.	97–99	−1	5 1 0
745,872	Stk.	Mar. 10	5	West Ham, 5 p.c. Ord.	97–102	..	4 18 0
				WATER COMPANIES.			
781,517	Stk.	Dec. 30	12	Chelsea, Ord.	360–365	..	3 5 9
150,000	"	"	5	Do. 5 p.c. Pref.	147–152	..	3 5 9
160,000	"	"	4½	Do. 4½ p.c. Pref. '75	137–142	..	3 3 5
175,785	"	Mar. 29	4½	Do. 4½ p.c. Deb.	132–137	..	3 5 8
1,720,560	Stk.	Mar. 29	8	East London, Ord.	220–225	..	3 11 1
654,740	"	Dec. 11	4½	Do. 4½ p.c. Deb.	134–139	..	3 4 9
1,524,288	"	"	3	Do. 3 p.c. Deb.	89–92	..	3 5 2
700,000	50	June 10	1:†	Grand Junction — 10 p.c. max.	134–138*	−1	4 6 11
310,000	Stk.	Mar. 29	4	4 p.c. Deb.	115–120	..	3 6 8
708,000	Stk.	Feb. 25	10	Kent	320–325	+2	3 1 6
160,000	"	"	7	Do. New, 7 p.c. max.	223–228	+3	3 1 5
1,043,800	100	Dec. 30	11	Lambeth, 10 p.c. max.	317–322	..	3 8 4
406,200	100	"	8½	Do. 7½ p.c. max.	230–235	+2	3 12 4
350,000	Stk.	Mar. 29	4	Do. 4 p.c. Deb.	115–120	..	3 6 8
500,000	100	Feb. 25	10	New River, New Shares	375–385	+10	2 12 0
1,000,000	Stk.	Jan. 28	4	Do. 4 p.c. Deb.	118–121	..	3 6 2
902,300	Stk.	Dec. 30	7½	South-wark and Ord. 7½ p.c. max. 5 p.c. Pref.	277–282	..	2 13 2
126,500	100	"	7½		215–225	..	3 6 8
489,200	Stk.	"	5		144–149	..	3 7 1
1,019,585	"	Mar 29	4	Vauxhall 4 p.c. A Deb.	115–120	..	3 6 8
1,155,066	Stk.	May 27	10	West Middlesex	298–303	+3	3 6 0
200,000	"	June 10	4½	Do. 4½ p.c. Deb.	130–135*	..	3 6 8
200,000	"	Mar. 10	3	Do. 3 p.c. Deb.	89–92	..	3 5 2
					* Ex div.		

† Next dividend will be at this rate.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The Stirling Gaslight Company have lodged a memorial with the Secretary for Scotland, objecting to an application by the Corporation of Stirling for authority to borrow a further sum of £4302 for their electric light undertaking. The Company point out that they are assessed upon a rental of £3682, and that last year they paid £338 in local rates, and £326 in poor and school rates. The Company is one of the largest ratepayers in the municipality. Their position is that the trebled cost to the community for public lighting is mainly caused by want of due consideration for economy and efficiency on the part of the Corporation, whose policy, it is contended, has been to extend public lighting by electricity, independent either of profit-earning capacity or public economy. No attempt has been made, on the the other hand, to introduce, on anything like an extensive or adequate scale, incandescent gas lighting for public purposes. Of the 245 gas-lamps now in use, the great majority have flat-flame lights, only 30 lamps having been fitted with incandescent mantles. The Gas Company supply these mantles free wherever incandescent gas lighting is adopted. The charge for electricity for public lighting is a fraction over 3d. per unit, which is more than four times the price for incandescent gas lighting with a 20-candle gas at 2s. 10d. per 1000 cubic feet, subject to a discount of 10 per cent. The prices charged by the Corporation to private consumers of current vary in amount; but the revenue derived therefrom, together with the amount received from public lighting, has been hitherto altogether inadequate to meet working expenses and provide interest and sinking fund. In all, £3879 has been taken from the rates to balance the net revenue account. In addition to the excessive and annually increasing amount paid by the community for public lighting, private consumers have been supplied with current at the cost of, and at considerable loss to, the great majority of the ratepayers, who do not use the light. The sums taken from the rates are equal to 4½d. in the pound upon the total valuation of the burgh. It is submitted that, as between a corporation and a company carrying on business under the strict conditions attached by Parliament to the privilege of incorporation, there is no sound reason for favouring one at the expense of the other, and that it is in the public interest that stringent conditions should be attached to further powers or loans. A copy of the memorial has been sent to the Town Clerk of Stirling.

Mr. W. B. M'Lusky, of Perth, has prepared a report upon the maintenance and inspection of consumers' gas fittings and burners, including gas cooking and heating apparatus. No official change, he says, has taken place in the methods of inspection during the past twenty years; nothing has been done to educate consumers in gas economy; and little or no attempt has been made to bring the most efficient of the innumerable variety of burners and fittings prominently under their notice, or to assist them in choosing the best from the limited selection which the local trader may offer. The Corporation do not propose to interfere with the recognized work of the fitting trade, or to compete with plumbers. Seven or eight years ago, there were no Corporation gas-stoves on hire; and the popular demand which the introduction of these appliances created shows no abatement. A reduction of 10d. per 1000 cubic feet in the price of gas would be welcomed by consumers; yet the waste of gas resulting from the employment of unsuitable burners or appliances represents a loss of from 10d. to 1s. 3d. per 1000 cubic feet in the consumers' accounts. A case—that of one of the largest consumers of gas in Perth—is given as an illustration. On the fittings of that important consumer, burners were found in daily use the total available light from which did not exceed 5-candle power, or equivalent to 8 candles per 5 cubic feet of gas consumed. Now all this is changed. During the past nine months, proper burners have been in use, and the amount of light developed by a consumption of 5 cubic feet per hour has been equivalent to 25-candle power; while a saving of about £100 per annum has been effected in the gas bill of the consumer. It is premised that the Corporation should not rest content with supplying gas and goods of standard quality, but that they should see to it that the public are getting standard results. The proposal is to appoint four inspectors—technically trained or practical men—each of whom would have charge of a district. The cost is estimated at about £200 for wages, and £100 for the supply of burners to consumers free—£300 in all. This is equal to about ½d. per 1000 cubic feet of gas consumed.

Returning to the Dundee Corporation gas accounts, the "Dundee Advertiser" of yesterday says that, "in addition to the details already given, the figures applicable to carburetted water gas, which for the first time appears in the estimates, are of interest. For the current year, the estimate provides for the use of a diminished quantity of coal—61,975 tons, yielding 9800 cubic feet per ton, as against 70,357 tons, yielding 9919 cubic feet per ton, actually carbonized last year. The installation of carburetted water gas, estimated to produce 100 million cubic feet, brings up the total estimated output to 705,589,000 cubic feet, against an actual production last year of 697,900,000 cubic feet. The cost of the coal bill last year was £39,552, and the estimate for the present year is £33,570. On benzol this year a saving is contemplated; the figures being £2437 and £2768 respectively. This year coal is down; the cost being stated at 10s. 10d., against 11s. 2·92d. last year. The estimate for carbonizing charges also shows a shrinkage, being stated at £46,684, against £49,470; the cost per ton of coal and benzol being 13s. 5·44d., contrasted with 14s. 0·75d., and the cost per 1000 cubic feet being 1s. 3·88d. for coal gas and carburetted water gas, against 1s. 5·01d. for coal gas last year. The cost of production of carburetted water gas is estimated at 1s. per 1000 cubic feet."

It was reported to the Dunfermline Town Council on Thursday that the make of gas during the past year was 103,743,000 cubic feet—an increase of 5,635,000 cubic feet over the preceding twelve months. The

MILBOURNE'S

PATENT LUTELESS

PURIFIERS

SAVE

GAS, GROUND SPACE, & CONNECTIONS.

ERECTED OR IN HAND AT THE FOLLOWING GAS-WORKS:

WREXHAM, DORKING, MITCHAM, RUGBY, EVESHAM, BOLOGNA (ITALY), SEDGELEY, VALPARAISO (CHILI), BANGOR (IRELAND), DRAYCOTT, BRITISH GAS COMPANY (ETRURIA STATION), STRATFORD-ON-AVON, KIDDERMINSTER, KETTERING, NORTH MIDDLESEX, &c., &c.

SOLE MAKERS—

C. & W. WALKER, LTD.,

Midland Iron Works:
DONNINGTON, NEWPORT, SALOP.

London Office:
110, CANNON STREET, E.C.

gas accounted for amounted to 99,205,300 cubic feet—an increase of 6,329,000 cubic feet.

The carriage of coal to Inverness formed the principal subject of discussion at a meeting of the Town Council there on Monday. The Manager—Mr. A. Thomson—reported that the 8000 tons of coal which they required would cost £7394 if carried by rail, and £6890 if carried by sea; showing a saving of £504 if sea carriage were adopted. Mr. J. Mackenzie, the Convener of the Gas Committee, moved that the Council approve of carriage by sea, and that the Manager be authorized to arrange for the cartage of the coal to the gas-works. Mr. Macberan, in seconding, said the £500 they would get was nothing to what they might be able to save in future years. Mr. Richard Duffy said he was led to understand, on good authority, that the deterioration of coal coming by sea would be at least 10 per cent. If they allowed for this deterioration, they would find that taking the coal by sea would mean some loss. He moved the previous question. Mr. R. Fraser seconded. Mr. Birnie did not think there would be a saving of £500. Of this sum, £100 would be taken out of the petty customs. He was afraid the proposal was really an experiment; but if the experiment was to be tried, they never had a better time than the present to carry it out. Mr. D. Ross considered it was not a matter of sympathy, but of pure business. It did not seem to him that the saving would be so great as was said. He thought the experiment might be tried of taking the harder class of coal by sea. The Railway Company were good customers to the town, consuming something like £1000 worth of gas a year. If the town took their coal by sea, the Railway Company might make their own gas. The proposal of the Committee was eventually adopted by 14 votes to 3.

Some idea of the benefit to be derived from exhibitions of gas appliances is given by the remarks of Bailie Martin at the opening of an exhibition in Peterhead on Monday. He stated that at the first exhibition which they held, in 1899, there were 68 gas-cookers sold, and at their second exhibition, in 1901, they sold 282 cookers and 138 prepayment cookers were ordered. The yearly revenue from the sale of gas had thus been increased by £1000. There were still, however, 1700 householders who had no gas-cookers; and he trusted that, by this exhibition, the number would be greatly reduced.

The report by the Directors of the Comrie Gas Company to the meeting last Tuesday, recommended a dividend at the rate of 6d. per share, and carried forward £20 to the current year. At the annual meeting of the Cambuslang Gas Company on Wednesday, it was reported that there was a profit of £2899 on the year's working. A dividend at the rate of 8 per cent. was declared, absorbing £2160; £500 was voted for depreciation; and the balance of £239 was carried forward. At the annual meeting of the Carluke Gas Company on Wednesday, it was reported that the revenue for the year amounted to £2761, and the expenditure to £1868; leaving a balance of profit of £893. A dividend at the rate of 10 per cent. was declared; debentures to the amount of £300 have been paid off; and £1458 has been carried forward. The price of gas has been reduced to 3s. 1½d. per 1000 feet.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June* 11.

Sulphate of Ammonia.

Greater interest in the forward position has reflected itself upon the spot market, and there has during the week been some improvement in values; the closing quotations being £11 17s. 6d. per ton f.o.b. Hull and Liverpool, and £12 per ton f.o.b. Leith. There is no accumulation of stock in the hands of makers, and, production being now at its minimum, there is no undue anxiety to sell current output. Shipments during May have been somewhat in excess of those for May, 1903, for although there has been a falling off in the takings for Spain, this has been more than balanced by extra requirements for other points. For delivery ahead there has been a considerable amount of buying, at up to £12 and £12 2s. 6d. per ton, according to position, f.o.b. at the ports, and at the close makers are seeking an advance upon these prices.

Nitrate of Soda.

This is firm on spot at 10s. to 10s. 3d. per cwt., according to quality, and purchases ahead can only be made at full prices.

LONDON, *June* 11.

Tar Products.

There is still very little business doing in tar products; and the market for most articles remains unchanged. Pitch is quiet. London makers ask 32s. to 33s., according to position; while on the east coast makers are offering at 32s., or, in the case of the best Yorkshire makes, 32s. 6d. On the west coast, prices may be taken as 30s. to 30s. 6d. Creosote still remains firm. There is one London maker who is willing to sell a small quantity at 1¼d.; but the others require 1⅜d., while in the North 1 7/16d. to 1½d. is asked. There are no sales to report in anthracene, and the ruling prices are still the same at 1⅜d. to 2d. for "A" quality. "B" makes, however, remain unsaleable. Crude carbolic is still in strong demand, and some quantity has been sold during the week at 2s. per gallon; but as a rule it is difficult to do business, as makers will not accept the prices offered by consumers. Liquid is quiet; and prices remain unchanged. One German maker reports having sold at equal to 9½d.; while English makers quote 10d. to 1s. per gallon. Crystals remain unchanged. London makers still ask 6¼d. for 34-35 per cent., and 6⅜d. for 39-40 per cent.; but no business is reported. Benzol is said to be slightly better; and makers are stated to have declined 9d. per gallon for 90 per cent., and 7¼d. for 59-90 per cent. There is no business to report in solvent naphtha, and prices still remain from 6½d. to 8d., according to quality. The sale of a fair quantity of toluol is reported at 7d. per gallon, and makers now ask 7½d. It is stated that a large tar contract was taken in the Midlands at a high price; but no further particulars have transpired.

The average values during the week were: Tar, 17s. 6d. to 22s. 6d.

THE

MAXIM PATENT CARBURETTOR

FOR ENRICHING GAS IN BULK.

PREVENTS NAPHTHALENE DEPOSITS.

OVER 120 MAXIM PATENT CARBURETTORS HAVE NOW BEEN FIXED.

Among the Companies and Towns supplied are The Gaslight and Coke Company, The South Metropolitan Gas Company, Birmingham, Leeds, Rochdale, Bristol, Sheffield, Oldham, Dundee, Perth, Dunfermline, and many other Works, both large and small, where they have been working in some instances for the past Ten Years.

MORE GAS & SALEABLE COKE PER TON of COAL CARBONIZED is PRODUCED; SAVING CAPITAL, LABOUR, FUEL, WEAR & TEAR, &c.

THE ENRICHMENT IS INSTANTANEOUS AND PERMANENT.

The Carburettor is inexpensive, easily fixed, and entirely supersedes the use of Cannel.

Dealers in Benzol, Carburine, and all other Naphthas and Oils suitable for the Enrichment or Production of Gas.

For Prices and full Particulars, apply to

THE GAS LIGHTING IMPROVEMENT COMPANY, LIMITED,

18, DEVONSHIRE STREET, BISHOPSGATE, LONDON, E.C.

Pitch, London, 32s. to 32s. 6d.; east coast, 31s. 6d. to 32s.; west coast, 30s. to 30s. 6d. Benzol, 90 per cent., 9d. to 9¼d.; 50-90 per cent., 7d. to 7¼d. Toluol, 7d. Crude naphtha, 3d.; solvent naphtha, 6¼d. to 8d.; heavy naphtha, 10d. to 10½d. Creosote, London, 1¼d. to 1⅜d.; North, 1⅜d. Heavy oils, 2¼d. to 2¾d. Carbolic acid, 60 per cent., 2s. Refined naphthalene, £5 to £8; salts, 22s. 6d. to 25s. Anthracene, "A" quality, 1¾d. to 2d.; "B" quality, 1d., nominal.

Sulphate of Ammonia.

The market for this article has been much steadier all the week, and closes with a firm tendency. Beckton still quote £11 17s. 6d.; while another large London Gas Company ask £12. Business is reported in London at £11 16s. 3d., on Beckton terms; and the ordinary London value may be taken as £11 15s. to £11 16s. 3d. In Hull, the market is steady, a fair business having been done at £11 13s. 9d. early in the week; and prices now rule at £11 15s.. Business is reported in Liverpool at £11 15s.; and the value may be taken as £11 15s. to £11 16s. 3d. The market in Leith is firm. Business is reported to have been done at £11 17s. 6d. early in the week; while makers now ask £12, and are reported to have refused £11 18s. 9d.

COAL TRADE REPORTS.

Lancashire Coal Trade.

During the past week, there has been little or no further business of importance in connection with the settlement of gas-coal contracts in this district; but it is reported that further railway contracts for locomotive fuel have been concluded outside Lancashire at prices ranging from 7s. 3d. to 7s. 9d. per ton at the pit. As to gas coals, there is nothing in the general position of the market to warrant any quotable change in prices from last week. The situation, however, exhibits no increasing firmness, but rather a very general tendency towards weakness. Good screened Wigan Arley gas coals may still be quoted at about 9s. 6d. to 9s. 9d. up to 10s. per ton at the pit in some instances, with Wigan four-feet, according to quality, ranging from 7s. 9d. and 8s. 3d. up to 8s. 6d. and 8s. 9d. For house-fire coals, the market gets worse, if anything, with very few of the best coal pits running more than three days per week. Pit rates remain without actually quoted change; but present selling prices are very irregular, according to special conditions or competition that is to be met. Best Wigan Arley house coals average about 13s. to 14s. per ton at the pit, seconds Arley and Pemberton four-feet 11s. to 12s., with common house-fire coals obtainable from 8s. 6d. and 9s. to 10s. Steam and forge coals meet with the same indifferent demand; and at present there is no immediate prospect of any appreciable improvement in the Lancashire industrial conditions. Common round coals are plentiful, and frequently prices are cut excessively low to effect clearances; common steam and forge coals being obtainable at from 7s. 6d. and 7s. 9d. up to about 8s. and 8s. 3d. at the pit. Supplies of engine fuel have been kept somewhat in check by the restricted working of the pits, but continue ample for all requirements, with inferior sorts generally plentiful on the market. Prices are about steady, ranging from 4s. to 4s. 6d. per ton at the pit for common Lancashire, 5s. to 5s. 6d. for medium, and 6s. to 6s. 6d. for the best qualities of slack. For shipment, there is a very slow ordinary inquiry, and common steam coals delivered at the ports on the Mersey or the Manchester Ship Canal are to be bought about 9s. to 9s. 3d., or a trifle under these figures in special cases.

Northern Coal Trade.

There has been rather more activity in the coal trade of the north-east during the last few days—partly because of the preparation that is usual before the great local holidays, and partly because the exports of coal seem to be fuller. Best Northumbrian steam coals are in fairly good demand at from 10s. 4½d. to 10s. 6d. per ton f.o.b., second-class steams vary from 8s. 9d. to 9s. 3d., and steam smalls are dull at from about 4s. 3d. to 5s., according to quality. In the gas coal trade, a few small contracts are reported; but they are not large enough to influence the market much, and are generally at prices near to 7s. 10d. to 8s. per ton, according to the quality and period over which the contract endures. Occasional cargoes of gas coals are quoted at about 8s. to 8s. 3d. for good Durham kinds; and the collieries are moderately well employed for this season of the year. Gas coke, being at the period of lowest production, is locally rather scarce, and is steady at about 13s. 3d. per ton f.o.b. on the Tyne. Some of the inland gas-works have slightly higher prices than they had.

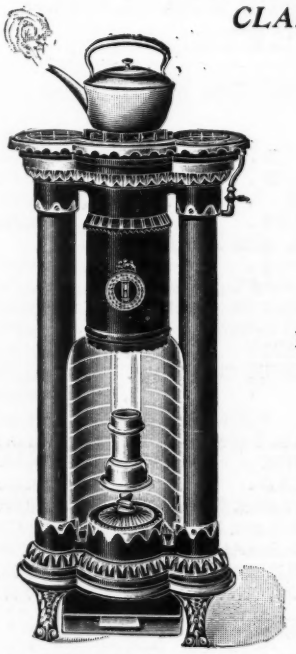
Scotch Coal Trade.

Trade continues to be quiet. Although there is a better demand for export, stocks are accumulating at the collieries. The prices quoted are: Main 7s. 3d. to 7s. 6d. per ton f.o.b. Glasgow, ell 8s. 3d. to 9s. 6d., and splint 8s. 3d. to 8s. 6d. The shipments for the week amounted to 258,733 tons—an increase upon the previous week of 14,882 tons, and upon the corresponding week of last year of 47,752 tons. For the year to date, the total shipments have been 4,579,251 tons—an increase of 149,729 tons upon the same period of 1903.

Incandescent Gas Lighting in Lambeth.—At the last meeting of the Lambeth Borough Council, the Lighting Committee reported that the work of installing the incandescent system of gas lighting in the Gaslight and Coke Company's district had been completed. The estimate was £2171, and the actual cost had been £2044. The Council passed an account of £174 4s. 11d.; being the first of the twelve quarterly instalments by which the Company will be repaid the £2044 4s. 11d. expended.

PURE HEAT.

WITHOUT SMOKE OR SMELL.



CLARK'S PATENT HYGIENIC

"SYPHON" STOVES

IMPROVED COMBINED

HEATING AND BOILING STOVE.

The Hot-Plate on Top being under separate control, **can be used during Summer Months.**

Adopted by the Leading Gas Companies.

WRITE FOR CATALOGUE.

S. CLARK & CO., Patentees and Makers, Compton Works, Canonbury Road, Highbury, London, N., and "Syphon" Works, Islington, N.
Show-Rooms: Bath House, 58, Holborn Viaduct, E.C. Telegrams: "Syphon Stoves London."

THE BEST STOVES

TO LET

ON HIRE

OR SELL.

Bangor Gas and Water Supply.—From a statement submitted by the Borough Accountant to the Finance Committee of the Bangor City Council, it appears that a profit of £3500 had been made by the gas-works during the past year, or an increase of £430 over the preceding twelve months. On the water-works a profit of £2100 was realized.

The King and Queen to Open the Birmingham Welsh Water-Works.—The Lord Mayor of Birmingham (Alderman Hallewell Rogers) has received an intimation from Lord Knollys to the effect that the King and Queen have graciously signified that they will open the new Elan Valley Water-Works. The date fixed is July 21; and the ceremony will take place at Rhayader. A special meeting of the City Council is to be held to-day, to make the necessary arrangements.

Alleged Further Pollution by the Crystal Palace District Gas Company.—At the meeting on Wednesday of the Lewisham Borough Council, the Sydenham and Forest Hill Committee reported the result of the action brought against the Crystal Palace District Gas Company in regard to the nuisance caused by the poilution of the Rivers Pool and Ravensbourne (ante, p. 517). A verdict had been returned against the defendants for £200 and costs; but notice of appeal had been given. Further complaints of pollution had since been received; and a notice had been served on the Company. It was resolved to instruct the Solicitor to institute proceedings in respect of the offences alleged to have been committed since the commencement of the action above referred to, and to retain Mr. W. J. A. Butterfield (who gave evidence for them at the trial) on behalf of the Council.

Consumption of Gas at Teignmouth.—At the meeting of the Teignmouth District Council last Tuesday, the Gas Manager (Mr. J. A. Gray) replied to some criticism in the local papers relative to the charges for gas, and said the allegations as to there being "enormous extraordinary and general increases" in the gas bills were based on inaccurate information. Exclusive of public lighting, the increase in the consumption in the March quarter, 1904, compared with the previous year, was 4·65 per cent.; and the revenue was increased by only 0·51 per cent. Mr. Gray also presented his annual report. This showed that the gross profit was £1974, equivalent to 11·72 per cent. on the capital account of the undertaking; and the profit balance was £646. The amount received for gas, at 4s. per 1000 cubic feet, was £4247. The quantity of coal carbonized was 2786 tons, against 2975 tons in the previous year—a reduction of 188 tons. The sale of coke produced £650, or £102 more, partly due to the more economical working of the new furnaces. The sales of sulphate of ammonia also realized £44 more, owing to the more efficient operation of the new purification plant. During the year the control of the public lighting passed into the hands of the Gas Department, who were maintaining the system at an annual charge of £93 less than was formerly paid for gas alone, and were thus effecting a saving of £200 per annum. Mr. Gray regretted that the Council were unable to foster the use of gas for cooking purposes to any considerable extent, so as to level-up the summer load—a result which would also be obtained by prepayment meters.

Devonport Gas Undertaking.—In moving the confirmation of the minutes of the Gas Committee of the Devonport Corporation last Thursday, Mr. W. Hornbrook, the Chairman of the Committee, took occasion to administer a rebuke to the croakers who are always expressing fears and forebodings with reference to the gas undertaking. The report for the year ended the 31st of March last showed a gross profit of £14,232, and a net profit of £1964. From this it was manifest that there would not be the terrible calamity or great loss that many people had predicted. With proper management he had no doubt that the gas undertaking would be a great success. Mr. H. Banbury, the Chairman of the Electric Power Committee, contended that the gas-works were not purchased at a low price, and that the Committee were not charging to revenue account all that should be put to it. If they had paid out of the revenue all they ought to have paid in replacing old mains with new ones, the reserve fund of £1900 would be reduced to very small proportions. He hoped they would not overburden the concern with capital. In his opinion, the Committee had gone the wrong way to work in carrying out great extensions and then considering the provision of water-gas plant. This plant should have been obtained first. Mr. Hornbrook replied that Mr. Banbury had been croaking ever since the Corporation acquired the gas-works; and he repeated his conviction that the undertaking would prove one of their best assets.

Gas Preferred to Electricity at Lisburn.—At last week's meeting of the Lisburn Urban District Council, a Committee appointed to procure information with regard to the merits of electricity and gas for lighting and power purposes reported that they had obtained interviews with several important authorities on the subject; and in consequence of the nature of the information received, they had formed the opinion that it would not be desirable, from any point of view, to commit the Council to a scheme for electrically lighting the town. They gathered that in a small place like Lisburn, without natural advantages—such as free water power—electricity could not hope to successfully compete with gas at 3s. 6d. per 1000 cubic feet—much less at the lower price at which it might be supplied in the not distant future. Glasgow was, they were informed, now engaged in removing arc lamps from some of the principal thoroughfares, and substituting incandescent gas-light in preference. Glasgow, with its cheap tram fares and cheap gas, was already catering for the wants of suburban townships up to a radius of 15 miles or more; and Belfast, the Committee believed, would not be long in following this example. The Committee recommended the Council to request the Lisburn Gas Company to consider the possibility of supplying gas at a more popular price; and if this were impracticable under existing circumstances, that the Company be interviewed as to their willingness to sell their undertaking to the Council. In the event of a refusal, it was recommended that the Council should petition the Belfast Corporation to take powers to supply the town with gas and electricity. The Council resolved that the Clerk should write to the Electric Company, informing them that the Council did not propose to go any further into their scheme; and that a deputation should wait on the Gas Company.

CARBURETTED WATER-GAS APPARATUS

Merrifield—Westcott—Pearson Patents.

The Economical Gas Apparatus Construction Co., Ld.

W. H. PEARSON, Chairman.
W. H. PEARSON, Junr., Deputy-Chairman.
J. T. WESTCOTT, Manager.
L. L. MERRIFIELD, M.Inst.M.E., Engineer.

London Offices: 19, ABINGDON STREET, WESTMINSTER, S.W.
American Offices: TORONTO. TELEGRAPHIC ADDRESS: "CARBURETED, LONDON."

CARBURETTED WATER-GAS ENGINEERS.

The above Company have erected since 1893, or are now erecting, their Universal Type of Carburetted Water-Gas Plant at the following Gas-Works:—

	Cub. Ft. Daily.		Cub. Ft. Daily.		Cub. Ft. Daily.
BLACKBURN	1,250,000	ST. CATHERINES (Remodelled)	250,000	TONBRIDGE	300,000
WINDSOR ST. WORKS, BIRMINGHAM	2,000,000	KINGSTON, PA.	125,000	STRETFORD	500,000
SALTLEY WORKS, BIRMINGHAM	2,000,000	PETERBOROUGH, ONT.	250,000	OLDBURY	300,000
COLCHESTER	300,000	WILKESBARRE, PA.	750,000	TODMORDEN	500,000
BIRKENHEAD	2,250,000	ST. CATHERINES (2nd Cont)	250,000	SALTLEY, BIRMINGHAM (Third Contract)	2,000,000
SWINDON (New Swindon Gas Co.)	120,000	BUFFALO, N.Y.	2,000,000	YORK (Second Contract)	750,000
SALTLEY, BIRMINGHAM (Second Contract)	2,000,000	WINNIPEG, MAN.	500,000	ROCHESTER (Second Contract)	500,000
WINDSOR ST., BIRMINGHAM (Second Contract)	2,000,000	COLCHESTER (Second Contract)	300,000	NEWPORT (MON.)	250,000
HALIFAX	1,000,000	YORK	750,000	TOKIO, JAPAN	1,000,000
TORONTO	250,000	ROCHESTER	500,000	PERNAMBUCO (Brazil)	125,000
OTTAWA	250,000	KINGSTON, ONT.	300,000	MALTON	150,000
LINDSAY (Remodelled)	125,000	DULUTH, MINN.	300,000	DULUTH, MINN. (2nd Cont.)	300,000
MONTREAL	500,000	CRYSTAL PALACE DISTRICT	2,000,000	BROCKVILLE (ONT.)	250,000
TORONTO (Second Contract Remodelled)	2,000,000	CATERHAM	150,000	SMETHWICK	500,000
BELLEVILLE	250,000	LEICESTER	2,000,000	GRAVESEND	300,000
OTTAWA (Second Contract)	250,000	ENSCHEDE (HOLLAND)	150,000	NEWPORT MON. (Second Contract)	250,000
BRANTFORD (Remodelled)	200,000	BUENOS AYRES (RIVER PLATE CO.)	700,000	TORONTO (Third Contract)	750,000
		BURNLEY	1,500,000	TORONTO (Fourth Contract)	1,000,000
		KINGSTON-ON-THAMES	1,750,000	MONTREAL, ONT. (2nd Cont.)	1,800,000
		ACCRINGTON	500,000	HAMILTON, ONT.	400,000

Complete Gas-Works at NELSON, BRITISH COLUMBIA.

LEEDS, 1,800,000 C. Ft. LEICESTER (2nd Cont.), 1,000,000 C. Ft. NEWCASTLE-ON-TYNE, 1,800,000 C. Ft.
AND, IN ADDITION, 3,000,000 CUBIC FEET DAILY.

Alexandria Water Company, Limited.—At the general meeting of this Company, held in Alexandria on the 2nd inst., a dividend of 7½ per cent. was declared. This, with 2½ per cent. interim dividend already paid, makes a return of 10 per cent. for the year ended March 31.

Increased Storage at Darlington.—In the paragraph on this subject which appeared in the "JOURNAL" last week, it should have been stated that the Contractors for the gasholder were Messrs. Newton, Chambers, and Co., Limited; the brick tank only having been constructed by Messrs. Smith Bros., of Burnley.

Increase in Price at Middleton.—In the "JOURNAL" last week (p. 664), we noticed the report of the Gas Engineer of the Middleton Corporation (Mr. E. E. J. Anderson) for the past financial year, which showed an adverse balance of £570, compared with a loss of £962 on the preceding twelve months' working. The Town Council have decided to increase the price of gas 3d. per 1000 cubic feet.

Gas and Water Profits at Carlisle.—The accounts of the gas and water undertakings of the Carlisle Corporation have been made up for the year ending March last, and show a gross profit on the supply of gas of about £11,000, the net profit being between £6000 and £7000. The profit is handed over to the city fund. On the water undertaking the profits are £6900 net, to be handed over to the district fund.

Increased Consumption at Loughborough.—The Loughborough Gas-Works earned a profit last year of £6854, or £700 more than in the preceding twelve months, notwithstanding a reduction of 2d. per 1000 cubic feet in price. There was an increase in consumption of 4½ per cent., due to the popularity of prepayment meters and the use of gas for cooking. On the other hand, the cost of manufacture was less. In submitting these facts to the Town Council, Alderman Bumpus acknowledged the excellent assistance the Gas Committee had received from the Engineer and Manager (Mr. E. Onions) and the staff, and said it was largely owing to them that the results were so satisfactory.

Proposed Reduction in Price at Bradford.—There is at present under consideration a proposition made by the Bradford Gas Committee to reduce the price of gas 2d. per 1000 cubic feet from July 1, on condition that the Finance Committee contribute an additional sum of £5000 per annum towards the cost of street lighting. Formerly the public lamps were paid for out of the gas profits; but two years ago the Council decided that a sum equal to about two-thirds of the cost should be made a charge upon the rates, and the price of gas (which was then 2s. 6d. per 1000 cubic feet) was reduced to 2s. 3d. For the financial year ended March 31, the total cost of street lighting (excluding electricity) was £29,450. Towards this the Finance Committee contributed from the rates £21,000; leaving £8450 to be borne by the Gas Committee.

Fleetwood Water Supply.—The water supply at Fleetwood having been deficient for some time, the Fylde Water Board are about to lay a new main from Bispham, at a cost of £16,000. The Board are also erecting new offices and workshops in Blackpool, at a cost of £8000. Having applied to the Local Government Board for power to borrow the money, Mr. E. A. S. Fawcett, one of their Inspectors, held an inquiry at Blackpool on Wednesday. The Engineer (Mr. Waring), said that in 1863 a 7-inch main was laid along the coast line from Bispham to Fleetwood, and in 1875 a 10-inch main along the eastern portion of the district. Since then the population had increased 175 per cent. No part of the town of Fleetwood was adequately supplied, and some of the higher portions were left without water in the busy days of summer. The new main would be 15 inches in diameter for 3 miles 300 yards, and 12 inches for four miles. There was no opposition.

Electric Lighting in Marylebone.—At the meeting of the Marylebone Borough Council on Thursday, a strong desire was expressed that the transfer of the Metropolitan Electric Supply Company's Marylebone undertaking to the Council should be effected, and the purchase-money for the property paid, as soon as possible. At the instance of Mr. Walter Leaf, the Chairman of the Finance Committee, it was unanimously decided that the Committee be empowered, "subject to the giving of the Royal Assent to the Borough Council's Electric Lighting Bill, to negotiate a temporary loan of £1,415,000, required to pay the amount of the arbitration award, the costs of the Bill, and of the judgment of the Courts; and to arrange for the payment of this amount at the earliest possible date, subject to the approval by the Council of the terms of the loan." It was also agreed to apply to the London County Council for their sanction to the borrowing of £436,500 for the purchase of a site and the erection of an electric generating station to admit of a direct supply and self-contained system.

The Bishop's Stortford District Council and the Gas-Works.—The Bishop's Stortford District Council went into Committee, at their meeting last Tuesday, to consider the subject of the proposed purchase of the gas-works. The General Purposes Committee reported that the Sub-Committee specially appointed on this subject had made inquiries with a view to obtaining particulars on the following points: (1) The means of ascertaining the maintainable profits; (2) the suggested number of years' purchase; (3) the proposed expenses connected with obtaining the Act, the arbitration, the winding-up of the Company, and the possible compensation to Directors and officials; and (4) the probable receipts. From the information obtained, the Sub Committee were of opinion that the question of maintainable income was one which could only be dealt with by an expert; and that upon the other matters probably approximately reliable figures could be ascertained. The Sub-Committee thought that expert information should be obtained also with regard to the first-named point; and it was therefore suggested that the General Purposes Committee should recommend to the Council as follows: (1) That an independent gentleman be appointed to give his opinion thereon; (2) that inquiries be made as to the cost of such opinion; and (3) that the Council authorize the payment thereof. The Committee submitted this report with the recommendation that a sum not exceeding 100 guineas be expended in obtaining the information referred to; and this course was agreed to.

PARKINSON'S SLOT COOKERS.

NEW DESIGNS.

Particulars on Application.

PARKINSON AND W. & B. COWAN, LTD.
(*Parkinson Branch*),
COTTAGE LANE, CITY ROAD, LONDON.
BELL BARN ROAD, BIRMINGHAM.

Water Scheme for Ampleforth.—A Local Government Board inquiry was recently held by Mr. R. H. Bicknell, M.Inst.C.E., with regard to an application by the Helmsley District Council for a loan for the purpose of carrying out a scheme of water supply for Ampleforth. The Engineer for the scheme is Mr. E. J. Silcock, M.Inst.C.E., of Leeds, who attended and explained the plans. The Inspector subsequently visited the preliminary works carried out, which have demonstrated the presence of a sufficient supply of water, obtained from the calcareous grits of the oolite series. There was no opposition.

Quality of the Water Supply at Saddleworth.—Some dissatisfaction having been expressed with the quality of the water supplied by the Ashton Joint Water Committee to Saddleworth, the opinion of Mr. Danckwerts, K.C., has been taken on the question whether the Urban District Council could lawfully expend public money in taking proceedings against the Joint Committee to enforce a supply of pure and wholesome water. Mr. Danckwerts states that they cannot do so; the matter is one between the consumers and the Joint Committee direct. If the water in the mains is not pure and wholesome, it is for the consumers themselves to take action. The Council, however, will approach the Local Government Board if the unsatisfactory supply continues, in the hope that they might be prevailed upon to interfere.

Injury Caused by a Projecting Water-Pipe.—In the King's Bench Division of the High Court of Justice a few days ago, before Mr. Justice Lawrance and a Special Jury, an action brought by Mr. Jaques, a London shipbroker, against the South Essex Water-Works Company, to recover damages for personal injuries owing to the alleged negligence of their servants, was heard. The injuries were caused by the plaintiff tripping over a water-pipe which had been allowed to project over the kerb in a badly-lighted road; the result being that his knee was hurt and varicose veins were developed. The defendants admitted their liability, and paid £101 into Court. In the result, the Jury found a verdict for the plaintiff for £250; and judgment for this amount was given accordingly.

Southport Gas Supply.—The report of the Southport Corporation Gas Committee for the year ending March 31 last shows that the total quantity of gas made was 451,332,000 cubic feet, the increase over the previous twelve months being 23,052,000 cubic feet, or 5·38 per cent. The total quantity sold was 389,384,000 cubic feet by the ordinary meters, and 20,986,100 cubic feet by prepayment meters; the public lamps using 30,539,600 cubic feet and private lamps 106,300 cubic feet. The gas sold for private consumption was 410,370,100 cubic feet; for private and public lighting, 30,645,900 cubic feet; used at works and offices, 2,256,400 cubic feet; and free gas, 477,000 cubic feet. The quantity unaccounted for was 7,582,600 cubic feet, or 1·68 per cent. There was an increase of 348 prepayment meters in the year, with an additional consumption of 3,985,200 cubic feet. The gross profit was £22,337—an increase of £101; and the net profit, £10,000, or a decrease of £86. The capital account at the end of the year stood at £266,148; and the gas-works debt, after deducting payments made through the sinking fund, at £197,950.

Messrs. Drakes Limited, of Halifax, have secured orders for the erection of their patent tube regenerator furnaces at Freshwater, Derby, Broadstairs, and Hindley.

The East Dereham Urban District Council have accepted the tender of Messrs. Robert Dempster and Sons, Limited, of Elland, for the gasholder recently advertised for in our pages.

The North Middlesex Gas Company have adopted, for the lighting of the streets of Hendon and Mill Hill, Messrs. W. Sugg and Co.'s patent "Windsor" lamp and their incandescent burner.

The Richmond Gas Stove and Meter Company, Limited, have recently held successful exhibitions at Belfast, Long Melford, Soham, Falmouth, Debenham, Huddersfield, Halifax, and Barnsley.

The Southwark Borough Council resolved last Wednesday to give their Resident Electrical Engineer three months' notice. The motion was strongly opposed, it being alleged that this official was made a scapegoat because the electric light undertaking could not compete with gas.

It is interesting to note, as showing that modern methods of gas manufacture are on the increase in small works, that Messrs. Biggs, Wall, and Co., of London, have received contracts for shallow regenerator settings at Tramore and Castlebar, and new exhausting plant at Skibbereen.

The Hayling Island Gas Company, Limited, has been registered with a capital of £3000, in £1 shares, to acquire the business of a gas-works proprietor now carried on by A. L. Emanuel, at Hayling Island, Hants; to manufacture, sell, and supply light in Hayling Island and elsewhere in the United Kingdom; and to carry on the business of gas and coke manufacturers, dealers in coal tar, ammoniacal liquor, and other residual products. There will be no initial public issue.

A competition, which was open to girls from the elementary schools, has recently been held at Chester, with the object of demonstrating the great ease with which cooking could be done by gas. There were 36 competitors, who were first asked to make a meat and potato pie, and subsequently a dish of rock cakes. Ten prizes were offered, the first being a dressing-case; and the competition was voted a great success. According to a local paper, the facility and ease with which the children handled the appliances were a revelation; while no less surprising was the short time in which the gas-cookers did their work, without the slightest inconvenience arising from the heat.

Orders have just been received by Messrs. W. J. Jenkins and Co., Limited, of Retford, for the De Brouwer patent hot-coke conveyor for the Fulham station of the Gaslight and Coke Company (third repeat order), the Avon Street works of the Bristol Gas Company, the Norwich works of the British Gaslight Company, the Tottenham and Edmonton Gas Company, and the Liverpool Street station of the Salford Corporation. In addition to these orders, the Farnworth and Kearsley Gas Company and the Neath, Stockton-on-Tees, and Blackburn Corporations have decided to adopt the "D.B." patent coal-projector. In the latter installation for charging, the machine will run on rails let in the floor, and will contain a fixed hopper carrying 5 tons of coal supplied from existing overhead hoppers.

Messrs. Hattersley, Sons, and Co., proprietors of the extensive spinning and weaving mills at Haworth, were in the past considerably inconvenienced by an indifferent gas supply. The trouble, however, was overcome by their installing a No. 5 size Keith's patent power-driven gas-compressor to increase the pressure of their ordinary gas supply to 2 inches. They also put in a small trial installation of the Keith light. This, after extended tests, has proved eminently satisfactory; and an order has been placed with the James Keith and Blackman Company, Limited, of London, to extend the system to their Springfield Mills, Mytholmes Mills, and Providence Mills. The lighting will be done by means of reflector fittings in 300 and 150 candle power units; the majority being fitted with patent electric lighters, which obviate the necessity of constantly burning pilot-lights. The existing No. 5 size power-driven compressor mentioned above only requires slight alteration to enable it to give the 8 inches pressure recommended by the makers for the Keith light. The total candle power of the new installation will amount to 61,000.

WANTED, FOR SALE, CONTRACT, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Situations Vacant.

MANAGER. Montrose Gas-Works.
WORKING MANAGER. Ware Gas Company.
ASSISTANT WORKS MANAGER. Sutton (Surrey) Gas Company. Applications by June 21.
MANAGER'S ASSISTANT. No. 4222.
DRAUGHTSMAN. C. & W. Walker, Donnington.
SHOW-ROOM ATTENDANT. No. 4221.
REPRESENTATIVE. "Refractory," care of Streets, Cornhill.

Agent Wanted for Oxide. Deacon, Leadenhall Street.

Situations Wanted.

ACCOUNTANT OR CHIEF CLERK. No. 4220.
ASSISTANT MANAGER. No. 4178.
BY STAFF PUPIL (Home or Abroad). Crauford, West Dulwich.

Plant, &c., for Sale.

CONDENSER (250,000 feet). Redditch Gas-Works.
ENGINE AND EXHAUSTER, HYDRAULIC MAIN, VALVES, &c. Bangor Gas-Works.
MOUTHPIECES, PIPES AND FITTINGS, BENCH FITTINGS, &c., LANTERNS, VALVES, STEAM ENGINE, &c. Cambridge Gas Company.
PURIFIERS. Neston Gas-Works.

Stocks and Shares for Sale.

ALDERSHOT GAS AND WATER COMPANY. June 21.
ASCOT GAS COMPANY. June 21.
BARKING GAS COMPANY. June 21.
EAST SURREY WATER COMPANY. June 22.
MAIDENHEAD GAS COMPANY. June 21.
NORTH MIDDLESEX GAS COMPANY. July 5.
REIGATE GAS COMPANY. June 22.

TENDERS FOR

Brass Fittings, &c.
HALIFAX GAS DEPARTMENT. Tenders by June 24.

Brimstone.
HALIFAX GAS DEPARTMENT. Tenders by June 24.

Carbon.
HALIFAX GAS DEPARTMENT. Tenders by June 24.

Coal and Cannel.
BLACKPOOL GAS DEPARTMENT. Tenders by June 24.
BRIDGNORTH GAS DEPARTMENT. Tenders by June 16.
BURY GAS DEPARTMENT. Tenders by June 18.
CARLISLE GAS DEPARTMENT. Tenders by June 27.
CHESTER GAS COMPANY. Tenders by June 21.
CHORLEY GAS DEPARTMENT. Tenders by June 21.
COLWYN BAY AND COLWYN GAS DEPARTMENT. Tenders by June 29.
EVESHAM GAS DEPARTMENT. Tenders by June 28.
EXMOUTH GAS COMPANY. Tenders by July 2.
GAINSBOROUGH GAS DEPARTMENT. Tenders by June 23.
HEREFORD GAS DEPARTMENT. Tenders by June 25.
KESWICK GAS COMPANY. Tenders by June 22.
LEAMINGTON PRIORS GAS COMPANY. Tenders by June 21.
LINCOLN GAS DEPARTMENT. Tenders by June 18.
LOUGHBOROUGH GAS DEPARTMENT. Tenders by June 25.
LYMM GAS DEPARTMENT. Tenders by June 22.
MARKET HARBOROUGH GAS DEPARTMENT. Tenders by June 24.
NORTHWICH GAS COMPANY. Tenders by June 24.
RHYL GAS DEPARTMENT. Tenders by June 24.
SAFFRON WALDEN GAS DEPARTMENT. Tenders by June 27.
SMETHWICK GAS DEPARTMENT. Tenders by June 23.
TORQUAY GAS COMPANY. Tenders by June 27.

Elevating and Coal-Breaking Plant.
OLDHAM GAS DEPARTMENT. Tenders by July 6.

Fire-Clay Goods.
CARLISLE GAS DEPARTMENT. Tenders by June 27.
OLDHAM GAS DEPARTMENT. Tenders by July 6.

Gas Oil.
HALIFAX GAS DEPARTMENT. Tenders by June 24.

Lime.
CHORLEY GAS DEPARTMENT. Tenders by June 21.
HALIFAX GAS DEPARTMENT. Tenders by June 24.
KEIGHLEY GAS DEPARTMENT. Tenders by June 20.

Oxide of Iron (New and Spent).
HALIFAX GAS DEPARTMENT. Tenders by June 24.

Purifiers.
MASTERTON (N.Z.) GAS DEPARTMENT.

Retort-Bench and Ironwork.
LONGFORD GAS COMPANY. Tenders by June 23.

Stoking Machinery.
OLDHAM GAS DEPARTMENT. Tenders by July 6.

Sulphuric Acid.
CHORLEY GAS DEPARTMENT. Tenders by June 21.
HALIFAX GAS DEPARTMENT. Tenders by June 24.
MARKET HARBOROUGH GAS DEPARTMENT. Tenders by June 24.

Tar and Ammoniacal Liquor.
ATHERTON GAS DEPARTMENT. Tenders by June 22.
BRIERLEY HILL GASLIGHT COMPANY. Tenders by June 24.
CHORLEY GAS COMPANY. Tenders by June 21.
GUILDFORD GAS COMPANY. Tenders by June 29.
KESWICK GAS COMPANY. Tenders by June 22.
LOUGHBOROUGH GAS DEPARTMENT. Tenders by June 25.
LYMM GAS DEPARTMENT. Tenders by June 22.
NEWARK GAS COMPANY. Tenders by June 23.
READING GAS COMPANY. Tenders by June 20.

Washer-Scrubber.
DURHAM GAS COMPANY. Tenders by June 30.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

TERMS OF SUBSCRIPTION to the "JOURNAL."

United Kingdom: One Year, 21s.; Half Year, 10s. 6d.; Quarter, 6s. 6d.
Payable in Advance. If credit is taken, the charge is 25s. a year.
Abroad (in the Postal Union): £1 7s. 6d., payable in Advance.

All Communications, Remittances, &c., to be addressed to WALTER KING, 11, BOLT COURT, FLEET STREET, LONDON, E.C.
Telegrams: "GASKING, LONDON." Telephone: P.O. 1571a Central.

OXIDE OF IRON.

O'NEILL'S OXIDE has a larger annual sale than all other Oxides combined.

SPENT OXIDE purchased in any district.

GAS PURIFICATION & CHEMICAL CO., LD.

JOHN WM. O'NEILL, Managing Director,

PALMERSTON HOUSE, LONDON, E.C.

WINKELMANN'S "VOLCANIC" FIRE CEMENT.

Resists 4500° Fahr. Best for GAS-WORKS.

ANDREW STEPHENSON, 182, Palmerston House, Old Broad Street, London E.C. "Volcanism, London."

SPENT OXIDE.

THE South Metropolitan Gas Company are always open to receive OFFERS of SPENT OXIDE.

Chief Office: 709, Old Kent Road, London, S.E.
Telegrams: "METROGAS, LONDON."

BROTHERTON & CO., LIMITED.

Offices: Commercial Buildings, LEEDS.
Correspondence invited.

TO GAS AND WATER OFFICIALS.

MELROSE CYCLES and Slot Copper COLLECTORS. Latest Design and lowest Prices. For Cash or gradual payments. Catalogue free.

MELROSE CYCLE COMPANY, COVENTRY.

SULPHURIC ACID for Sale, specially suitable for making Sulphate of Ammonia.

BROTHERTON AND CO., LTD., Chemical Manufacturers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

HYDRATED OXIDE OF IRON.

PREPARED from Pure Iron.

Twice as Rich as Bog Ore.
Gives no Back Pressure.
The Cheapest in the Market.
Can be Lent on Hire.
Can be Exchanged for Spent Oxide.

READ HOLLIDAY AND SONS, LTD., HUDDERSFIELD.

SPECIAL PAINT FOR GAS-WORKS.

JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS,
MANCHESTER.

Telegrams: "ENAMEL." National Telephone 1759.

AMMONIACAL LIQUOR wanted.

BROTHERTON AND CO., LTD., Ammonia Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

PATENTS AND TRADE MARKS

PUBLICATIONS. "MERCHANDISE MARKS ACT, and Decisions thereunder," 1s.; "TRADE SECRETS v. PATENTS," 6d.; "DOCTRINE of EQUIVALENTS, Mechanical and Chemical," 6d.; SUBJECT-MATTER of PATENTS," 6d.

MEWBURN, ELLIS, & PRYOR, Chartered Patent Agents, 70 and 72, Chancery Lane, London, W.C. Telegrams: "Patent London." Telephone: No. 243 Holborn.

GAS TAR wanted.

BROTHERTON AND CO., LTD., Tar Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

PENNY-IN-THE-SLOT WORK.

H. GREENE & SONS, Ltd., are pre- pared to give QUOTATIONS to Gas Companies or Corporations for FITTING UP COMPLETE and CARRYING OUT the WORK in its entirety, either in Iron or Compo.

SURREY ENGINEERING WORKS, BLACKFRIARS ROAD, LONDON, S.E.
Telephone: 1693 HOP. Telegrams: "LUMINOSITY."

COAL GAS TAR wanted.

ROBINSON BROTHERS, LIMITED. Works: WEST BROMWICH, KNOTTINGLEY, and SPONDON.

SULPHATE OF AMMONIA

SATURATORS and LEAD WORK for Sulphate of Ammonia Plants.

For REPAIRS or ALTERATIONS, ring up "0848 BOLTON," or Telegraph "SATURATORS, BOLTON."

Largest Practice and most Up-to-Date Works Britain.

JOSEPH TAYLOR AND CO., CENTRAL PLUMBING WORKS, BOLTON.

J. & J. BRADDOCK (Branch of Meters Limited), Globe Meter Works, OLDHAM, and 45 & 47, Westminster Bridge Road, LONDON, S.E.

WET AND DRY GAS-METERS, PREPAYMENT METERS, STATION METERS, AND GOVERNORS.

REPAIRS RECEIVE PROMPT ATTENTION.

Telephones: 254 Oldham, and 2412 HOP, London.
Telegrams:—
"BRADDOCK, OLDHAM," and "METRIQUE, LONDON."

DUTCH OXIDE OF IRON.

THE First Dutch Bog Ore Co., Ltd., (Eerste Hollandsche Yzererts Maaty), ROTTERDAM.

General Manager (for England and Wales)—
CHARLES E. FRY, LEAMINGTON; and at Tower Chambers, Brown Street, MANCHESTER.

London Managers—
E. PADFIELD & CO., 96-98, Leadenhall Street, LONDON, E.C.

General Manager (for Scotland)—
J. B. MACDERMOTT, 11, Bothwell St., GLASGOW.

SULPHURIC ACID.

SPECIALLY prepared for the Manu- facture of SULPHATE OF AMMONIA.

SPENCER, CHAPMAN, AND MESSEL, LIMITED, 36, Mark Lane, LONDON, E.C. Works: SILVERTOWN.
Telegrams: "HYDROCHLORIC, LONDON."
Telephone: 341 AVENUE.

ATTERTON'S Patent Charging Machine, especially adapted for Small Works up to 50 Millions. Nearly 40 already supplied, and still supplying. Would soon repay for small outlay. Increased make and reduction in cost.

Apply to E. PADFIELD AND CO., 96 & 98, Leadenhall Street, LONDON, E.C.

JOHN RILEY & SONS, Chemical Manu- facturers, Hapton, near Accrington, are MAKERS of Special SULPHURIC ACID, for Sulphate of Ammonia Making. Highest percentage of Sulphate of Ammonia obtained from the use of this Vitriol, which has now been used for upwards of 50 Years. References given to Gas Companies.

APPOINTMENT Wanted as Account- ANT or CHIEF CLERK in a Gas or Gas and Water office. Over Twelve Years' Experience. First-class Testimonials.

Address No. 4220, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

APPOINTMENT wanted as Assistant- MANAGER in Gas-Works. Trained at Engineering Works. Recently prepared Drawings and Superintended erection of large up-to-date Gas-Works. Good knowledge of Chemistry and Gas-Works Routine. Honours Gas Manufacture.

Address No. 4178, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

STAFF Pupil (age 24) approaching end of Three Years' pupilage in the Gaslight and Coke Company, London, wants EMPLOYMENT at Home or Abroad. Engineering Experience at College, and trained in each branch of Gas Manufacture and Distribution, Drawing Office Practice, and Worshops. Good Testimonial.

Address, S. A. G. CRAUFORD, Britannia House, Thurlow Park Road, WEST DULWICH.

GAS Manager wanted by the Montrose Gaslight Company.

For Particulars, apply to ALEX. MUIRDEN, Chairman of the Company, MONTROSE.

WANTED, a Smart Young Man (age 19 to 22) for a Gas Company's Show-Room. Must be a pushing Salesman. Previous Experience with Fittings and Stoves necessary.

Apply, by letter, stating Age, Experience, and Wages required, to No. 4221, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

DRAUGHTSMAN Wanted, thoroughly familiar with Gasholders and general Gas-Works Plant, and capable of making Working Drawings and taking out Quantities for estimating or ordering Materials.

State Age, Experience, and Salary required.

C. & W. WALKER, Limited, Midland Iron-Works, Donnington, SHROPSHIRE.

OXIDE OF IRON.
(NATURAL.)

BALE & CHURCH will be pleased to send Samples and Quotations, and make Offers for SPENT OXIDE.

BALE'S FIRE CEMENT, PAINT, AND GAS COAL

5, CROOKED LANE, LONDON, E.C.

COAL GAS TAR wanted.
BEST PRICES GIVEN.

SHARPNESS CHEMICAL COMPANY, LIMITED, Sharpness Docks, GLOS.

AGENTS wanted by an Old-Established firm to sell OXIDE OF IRON in Lancashire and Scotland. Must have a Good Connection among Gas Companies.

Address, by letter, "OXIDE AGENT," care of S. Deacon and Co., LEADENHALL STREET, E.C.

REPRESENTATIVE wanted for the sale of Special Refractory Cement for Gas-Retorts and other Gas-Works purposes. Must have necessary Connection and be a pushing Salesman.

Apply, with full Particulars, References, Age, and Terms expected, to "REFRACTORY," care of Street's, 30, CORNHILL, E.C.

MANAGER'S Assistant wanted in a Gas-Works in the West of England. Must have some knowledge of Gas-Works routine, Chemistry, and Mechanical Drawing. Commencing Salary £100 per Annum.

Apply, stating Age, Training, &c., with *copies* of Testimonials, to No. 4222, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WARE GASLIGHT AND COAL AND COKE COMPANY, LIMITED.

WANTED, immediately, a Competent WORKING GAS MANAGER, to Take Charge of the Works of the above Company. Must be thoroughly efficient, and be accustomed to Regenerative Retorts. Salary to commence £120 per Annum, with Home, Fuel, and Light.

Full Particulars may be obtained of the undersigned.

GEO. H. GISBY,
Secretary.

Town Hall, Ware,
June 8, 1904.

THE Directors of the Sutton (Surrey) Gas Company invite APPLICATIONS for the appointment of ASSISTANT WORKS MANAGER. He should be able to take entire charge of the Works in the absence of the Manager, and be accustomed to the control of men, and have had practical experience in Main and Service Laying, Meter Taking, and all branches of Manufacture, Purification, Distribution, and Testing of Gas.

Coal carbonized per annum, 16,000 Tons.

Applications, in own hand-writing, accompanied by Three recent Testimonials, and giving Full Particulars of Experience, Age, and Salary required, to be sent in on or before June 21, endorsed "Assistant-Manager," and addressed to the SECRETARY, Gas Office, Sutton, SURREY.

CAMBRIDGE UNIVERSITY AND TOWN GASLIGHT COMPANY

HAVE for Sale the following Second- hand PLANT:

100 18 in. by 14 in. ⌂ MOUTHPIECES, with 6-inch Sockets and Wrought-Iron Lids, Cross-Bars, and Screws.
98 ASCENSION-PIPES and BENDS, 6-inch to 5-inch.
98 DIP-PIPES, 4 and 5 inch.
10 9 feet Lengths of 20-inch diameter Cast-Iron HYDRAULIC MAIN.
49 feet of 18-inch diameter Wrought-Iron HYDRAULIC MAIN.
90 Wrought-Iron BUCKSTAYS, about 9 ft. 6 in. long.
280 feet of 2-inch diameter Wrought-Iron TIE-RODS, in 9 lengths, with Screwed Ends, Coupling Boxes, and Nuts.
180 feet of 1¾-inch diameter Wrought-Iron TIE-RODS, in 10 lengths, with Screwed Ends, Coupling Boxes, and Nuts.
1000 LANTERNS, suitable for Flat-Flame Burners.
100 Wrought-Iron CRADLES for same.
One 15 in. Donkin RACK-VALVE, Flanged.
Five 14 in. " " " "
Three 14 in. " " " Socket and Spigot.
Two 12 in. " " " Flanged.
One 10 in. " " " Socket and Spigot.
Four 8 in. " " " Flanged.
One Horizontal STEAM-ENGINE, by Gwynne, 7 in. by 12 in. Cylinder, Disc Crank, suitable for 25,000 feet Exhauster.

For further Particulars, apply to
G. W. AUCHTERLONIE,
Engineer and Manager.

ROBERT DEMPSTER & SONS, Ltd., Contractors for Complete CARBONIZING PLANTS and every description of GAS APPARATUS and ELEVATING and CONVEYING PLANT, ROSE MOUNT IRON-WORKS, ELLAND.

FOR SALE—Two 6 feet by 6 feet Purifiers, by Dempster, with two Four-Way Valves. Replaced by larger
Apply to A. E. ASHLEY, Manager, Gas-Works, NESTON.

CONDENSER for Sale. In splendid Condition. Cheap. Capacity 250,000 Cubic Feet per Twenty-four hours.
Apply to A. E. LAYTON, Manager, Gas-Works, REDDITCH.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.
J. F. BLAKELEY, Gas Engineer, Thornhill, DEWSBURY.

GASHOLDER, 40 ft. diameter by 14 ft. deep, in wrought Tank, with six Columns, trellis Girders, and Suspension Gear. In splendid condition. Nearly new.
New GASHOLDER, 40 ft. diameter by 12 ft. deep, with Steel Standards; also new STEEL TANK to contain same.
Write J. WRIGHT, 181, Queen Victoria Street, LONDON, E.C.

GAS PLANT FOR SALE.

THE Corporation of Bangor, North Wales, have the following PLANT for Sale:—
One 10,000 feet per hour EXHAUSTER, with STEAM-ENGINE on one Bed-Plate.
Two lengths of HYDRAULIC MAIN, with 7-inch Valves, 5 inch H Pipes, and 6-inch to 5-inch Ascension Pipes.
The Engine may be seen in use.
Further Particulars may be had on application to the undersigned.

JOHN SMITH,
Manager.

June 10, 1904.

CITY OF HEREFORD.

THE Gas Management Committee of the Corporation invite TENDERS for the supply of best screened large GAS COAL for One Year, from the 1st of July next, to be delivered free at the Gas-Works Siding, Hereford, in such quantities as may be required from time to time.
The estimated quantity required will be about 13,000 Tons.
Full Particulars and printed Forms of Tender may be obtained on application to the undersigned.
Tenders, endorsed "Tender for Gas Coal" are to be sent in addressed to the Chairman, Gas Management Committee, Mansion House, Hereford, by Saturday, June 25, 1904.
The Committee do not bind themselves to accept the lowest or any Tender.

By order,
WILLIAM PARLBY,
Gas Engineer and Manager.

Gas-Works, Hereford,
June 3, 1904.

TAR AND AMMONIACAL LIQUOR.

THE Lymm Urban District Council are prepared to receive TENDERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR made at their Gas-Works, for a term of One Year from the 1st day of July, 1904 (or for such longer term as may be contracted for with the consent of the Council).
Tar and Liquor will be delivered free into Contractor's Boat on the Bridgwater Canal.
Tenders, to be sent to the undersigned on or before the 22nd day of June, 1904, endorsed "Tar."
The purchaser will be required to enter into an agreement with the Council for the due performance of his Contract.
The Council do not bind themselves to accept the highest or any Tender.
Forms of Tender are not supplied.
Further Particulars may be had on application to the Gas Manager, Mr. W. L. Donaldson.

W. MULLARD,
Clerk.

Council Offices, Lymm, Cheshire.
June 3, 1904.

URBAN DISTRICT COUNCIL OF LYMM.

THE above Council are prepared to receive TENDERS for the supply of CANNEL and best screened GAS COAL, to be delivered at their Gas-Works in Lymm, for a term of Twelve Months from the 1st day of July, 1904.
The probable quantities required will be about 250 Tons of Cannel and about 1800 Tons of Gas Coal, which must be freshly wrought, well screened, and free from Sulphurous Pyrites and other Objectionable Matter; but the Council reserve the right of increasing or decreasing the quantities named.
The person whose Tender is accepted will be required to enter into an agreement with the Council for the due performance of his Contract.
Sealed Tenders, stating price per ton delivered alongside the Works, to be sent to the undersigned on or before the 22nd day of June, 1904, and endorsed "Coal Tender."
The Council do not bind themselves to accept the lowest or any Tender.
Forms of Tender are not supplied.
Further Particulars may be had on application to the Gas Manager, Mr. W. L. Donaldson.

W. MULLARD,
Clerk.

Council Offices, Lymm, Cheshire,
June 3, 1904.

CITY OF CARLISLE.

THE Carlisle Gas Committee are prepared to receive TENDERS for the COAL and CANNEL required at their Works during One Year from the 1st of July next.
Tenders, endorsed "Coal," and addressed to the Chairman of the Gas Committee, to be delivered at the office of the Town Clerk, not later than June 27, 1904.
Forms of Tender and other Particulars may be had on application to the undersigned.

By order.
W. J. SMITH,
Engineer and General Manager.

Gas-Works, Carlisle,
June 7, 1904.

CITY OF CARLISLE.

THE Carlisle Gas Committee are prepared to receive TENDERS for the FIRE-CLAY, RETORTS, BRICKS, &c., required at their Works during One Year from the 1st of July next.
Tenders, endorsed "Fire-Clay," and addressed to the Chairman of the Gas Committee, to be delivered at the office of the Town Clerk not later than June 27, 1904.
Form of Tender, giving quantities, &c., will be forwarded on application.

By order,
W. J. SMITH,
Engineer and General Manager.

Gas-Works, Carlisle,
June 7, 1904.

CORPORATION OF LOUGHBOROUGH.
(GAS DEPARTMENT.)

TENDERS FOR COAL.

THE Gas Committee of the above are prepared to receive TENDERS for the supply of the whole or part of 8500 Tons of unscreened GAS COAL or NUTS, to be delivered at Loughborough Station at such times and in such quantities as may be required during the Year from July 1, 1904, to June 30, 1905.
Tenders to be addressed to the undersigned, and to be delivered not later than Saturday, the 25th of June, 1904.
The Committee do not bind themselves to accept the lowest or any Tender, and reserve themselves the power to accept a portion of a Tender.

By order,
EDWARD ONIONS,
Engineer and Manager.

June 8, 1904.

CORPORATION OF LOUGHBOROUGH.
(GAS DEPARTMENT.)

TENDERS FOR TAR AND AMMONIACAL LIQUOR.

THE Gas Committee invite Tenders for the surplus TAR and AMMONIACAL LIQUOR for Twelve Months from July 1, 1904, to June 30, 1905.
Estimated amount of Tar, 600 Tons; Liquor, 1000 Tons.
The Contractor to state price for Water at 5° Twaddel, and per Ton extra for every ½° above 5°.
The Corporation to deliver both Tar and Water into Contractor's boats at the Derby Road Wharf, Loughborough.
The Committee do not bind themselves to accept the lowest or any Tender, which is to be endorsed "Tenders for Tar," and delivered to the undersigned at the Gas Offices, Loughborough, by Saturday, the 25th of June, 1904.

By order,
EDWARD ONIONS,
Engineer and Manager.

June 8, 1904.

BOROUGH OF CHORLEY.

TO COLLIERY OWNERS AND OTHERS.

THE Chorley Corporation invite Tenders for the supply of GAS FUEL required at their Gas-Works for a period of Twelve Months from the 1st of July, 1904.
Forms of Tender and Particulars and Quantities may be obtained on application to Mr. J. W. Allin, Gas Engineer, Chorley.
Tenders, endorsed "Gas Fuel," to be sent to me on or before Tuesday, June 21, 1904.
The Corporation do not bind themselves to accept any Tender.

By order,
JNO. MILLS,
Town Clerk.

Town Hall, Chorley,
June 6, 1904.

BOROUGH OF CHORLEY.
(GAS DEPARTMENT.)

THE Chorley Corporation invite Tenders for the following:—

1.—PURCHASE OF SURPLUS TAR, about 700 Tons.
2.—SUPPLY OF LUMP LIME, SMALL LIME, or LIME ASHES, 600 Tons, or thereabouts.
3.—SUPPLY OF BRIMSTONE ACID, 100 Tons, or thereabouts.
4.—SUPPLY OF PYRITES ACID, 150 Tons, or thereabouts.

} For Twelve Months commencing July 1, 1904.

Form of Tender for Acid, or any other Information, may be obtained on application to Mr. J. W. Allin, Gas Engineer, Chorley.
Tenders, duly endorsed, to be delivered to me on or before Tuesday, the 21st of June, 1904.
The Corporation do not bind themselves to accept any Tender.

By order,
JNO. MILLS,
Town Clerk.

Town Hall, Chorley,
June 6, 1904.

CORPORATION OF BLACKPOOL.
(GAS DEPARTMENT.)

THE Gas Committee are prepared to receive TENDERS for the supply of COAL for the ensuing Year from the 1st of July.
Forms of Tender may be had from the undersigned, and must be sent in by the 24th of June (endorsed outside), and addressed to the Chairman of the Gas Committee.

By order,
JOHN CHEW,
Gas Engineer.

Gas Office, Princess Street,
June 10, 1904.

BOROUGH OF SAFFRON WALDEN.

TENDERS FOR COAL.

THE Gas and Water Undertaking Committees of the Town Council are prepared to receive TENDERS for the supply of about 1450 Tons of best Screened GAS COAL, and about 220 Tons of best Hand-Picked Hard STEAM COAL respectively, for the Twelve Months ending the 30th of June, 1905.
Full Particulars can be obtained on application to Mr. A. H. Forbes, Borough Surveyor.
Sealed Tenders, endorsed "Tender for Gas Coal," or "Tender for Steam Coal," as the case may be, to be addressed and sent to me, the undersigned, not later than Five o'clock in the afternoon, on Monday, the 27th day of June inst.
The lowest or any Tender will not necessarily be accepted.

W. ADAMS,
Town Clerk.

Saffron Walden, June 8, 1904.

NEWARK GAS COMPANY.

TO TAR DISTILLERS AND OTHERS.

THE Directors of the Newark Gas Company are prepared to receive TENDERS for the purchase of the surplus TAR (about 500 Tons) produced at their Works, free on rail Great Northern Rly. or Midland Rly. in Purchaser's Tanks, for One Year from the 1st day of July, 1904.
Terms, cash monthly.
Further Particulars can be obtained on application to the undersigned to whom sealed Tenders are to be sent on or before the 23rd inst., marked on the outside "Tender for Tar."
The Directors do not bind themselves to accept the highest or any Tender.

By order,
F. B. FOOTTIT,
Secretary.

Newark, June 8, 1904.

GUILDFORD GASLIGHT AND COKE COMPANY.

TO TAR DISTILLERS.

THE Directors of the above Company are prepared to receive TENDERS for the surplus COAL-GAS TAR and CARBURETTED WATER-GAS TAR, separately or mixed, produced by the above Company, for the Year ending June 30, 1905.
Coal carbonized about 12,000 Tons per annum.
All Tenders to state the price per cask of 40 gallons.
Cartage to and from the Railway Station, Guildford, free. All empties to be provided by Contractor.
Tenders, endorsed "Tar," to be sent to William Baker, Esq., J.P.C.A., Chairman of the Gas Company, Guildford, on or before Wednesday, June 29, 1904.

By order,
WILLIAM TITLEY,
Secretary.

Gas-Offices, Guildford,
June 4, 1904.

RHYL URBAN DISTRICT COUNCIL.

TENDERS FOR COAL.

THE Rhyl Urban District Council are prepared to receive TENDERS for the supply of 5000 Tons of screened GAS COAL, to be delivered f.o.r. Rhyl between July 1, 1904, and June 30, 1905, in such quantities and at such times as may be required.
Form of Tender and Particulars of Conditions may be obtained on application to Mr. Leonard G. Hall, Assoc. M.Inst. C.E., Gas Engineer.
Sealed Tenders, endorsed "Tenders for Coal," to be delivered to me, the undersigned, not later than Nine a.m. on Friday, the 24th of June.
Approved security will be required.
The Council do not bind themselves to accept the lowest or any Tender.

ARTHUR ROWLANDS,
Clerk to the Council.

Council Offices, Clwyd Street, Rhyl,
June 6, 1904.

EXMOUTH GAS COMPANY.

THE Directors of the Exmouth Gas Company invite TENDERS for the supply of 4500 to 5000 Tons of Best GAS COAL (screened or unscreened) to be delivered in such quantities and at such times as may be required from the 1st of August, 1904, to the 31st of July, 1905, and to weigh 20 cwt. to the Ton over the Gas Company's or Dock Company's weighbridge (the said machines are regularly inspected by the Officer under the Weights and Measures Act), the Coal to be fresh wrought, dry, and free from Hards, Smudge, Dirt, Shale, and Pyrites.
Tenders to be accompanied by practical working analysis. Prices may be quoted c.i.f. or f.o.b. Exmouth Docks, or f.o.r. Exmouth Railway Station (L. & S.W. Railway).
Sealed Tenders, endorsed "Tender for Coal," to be addressed to J. Palmer, Esq., Chairman, and delivered to the undersigned not later than Saturday, the 2nd day of July, 1904.
The Directors do not bind themselves to accept the lowest or any Tender.
Forms of Tender are not supplied.

JAMES T. FOSTER,
Secretary and Manager.

Gas-Works, Exmouth,
June 9, 1904.

THE Directors of the Northwich Gas Company are prepared to receive TENDERS for the supply of about 6000 Tons of GAS COAL during the Year ending June 30, 1905.

Form of Tender and any other Particulars can be had on application to the undersigned.

Sealed Tenders, endorsed "Coal," and addressed to the Chairman, must be delivered here not later than Ten a.m. on Friday, June 24.

SAMUEL S. MELLOR,
Manager and Secretary.

Gas Offices, Northwich,
June 6, 1904.

THE CITY OF DURHAM GAS COMPANY.

THE Directors of the above Company are open to receive TENDERS for the supply of a Rotary WASHER-SCRUBBER, to deal with 750,000 cubic feet of gas per day.

Further Particulars can be obtained from Mr. A. B. Tobey, Work's Manager.

Sealed Tenders, addressed to the Chairman, to be sent to the undersigned on or before the 30th inst.

THOS. M. WALLER,
Secretary.

18, Claypath, Durham,
June 6, 1904.

CHESTER UNITED GAS COMPANY.

THE Directors invite Tenders for the supply of about 20,000 Tons of screened GAS COAL, during the Year ending June 30, 1905.

Particulars and Conditions for Tendering can be had upon application to the undersigned, to whom sealed Tenders must be delivered not later than Tuesday, June 21.

FRED A. PYE,
General Manager.

Gas Offices, Cupp'n Street, Chester,
June 8, 1904.

LEAMINGTON PRIORS GAS COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the Leamington Priors Gas Company are prepared to receive TENDERS for the supply of GAS COAL required by them during Twelve Months from the 1st of July next.

Particulars and Forms of Quotation may be obtained from the undersigned.

Tenders must be sent in on or before Tuesday, the 21st of June.

THOMAS BERRIDGE,
Engineer and Secretary.

URBAN DISTRICT COUNCIL OF COLWYN BAY AND COLWYN.

(GAS DEPARTMENT.)

THE above Council invite Tenders for the supply of approximately 4500 Tons of best screened GAS COAL, to be delivered during the Twelve Months ending June 30, 1905, as required, free at Colwyn Bay Station.

Sealed Tenders, stating price per Ton, and endorsed "Tender for Coal," to be sent in, addressed to the undersigned, on or before Wednesday, the 29th inst.

Further Particulars on application to the Engineer and Manager, Mr. J. C. Pennington.

The Council do not bind themselves to accept the l west or any Tender, and reserve the right to purchase any portion of the quantity offered.

By order,
JOS. H. ROBERTS,
Clerk.

Council Offices, Colwyn Bay,
North Wales, June 7, 1904.

LINCOLN CORPORATION.

(GAS DEPARTMENT.)

TENDERS FOR COAL.

THE Gas Committee of the Lincoln Corporation invite TENDERS for the supply of 26,000 Tons of screened or unscreened GAS COALS, to be delivered during a period commencing the 1st of July, 1904, and terminating the 30th of June, 1905.

Further Particulars and Forms of Tender may be obtained from the undersigned.

Sealed and endorsed Tenders, addressed to the Chairman of the Gas Committee, must be delivered on or before the 18th of June next.

The Committee do not bind themselves to accept the lowest or any Tender.

JNO. CARTER,
Manager.

Gas Offices, Lincoln, May 30, 1904.

MARKET HARBOROUGH URBAN DISTRICT COUNCIL.

(GAS DEPARTMENT.)

TENDERS FOR GAS COAL AND SULPHURIC ACID.

THE Gas Committee invite Tenders for—

GAS COAL.

The supply of the whole or part of 4000 Tons of best screened GAS COAL or NUTS, to be delivered as may be required during the Year ending June 30, 1905, at the Sidings of the London and North-Western or Midland Railway Station, Market Harborough.

SULPHURIC ACID.

The supply of SULPHURIC ACID, to be delivered in senders' Carboys at Market Harborough Station as may be required during the Year ending June 30, 1905.

Conditions and Form of Tender may be obtained from the undersigned, to whom sealed Tenders, endorsed "Coal" and "Sulphuric Acid," respectively, must be delivered not later than Friday, the 24th inst.

The lowest or any Tender not necessarily accepted.

A. T. HARRIS,
Manager and Secretary.

Gas Office, St. Mary's Road,
Market Harborough, June 4, 1904.

THE Directors of the Keswick Gas Company invite TENDERS for the supply of 1700 Tons of best screened GAS COAL, or NUTS, to be delivered at Keswick Railway Station, between the 1st of July, 1904, and the 30th of June, 1905, in such quantities and at such times as may be required.

Tenders, stating price per ton, endorsed "Tenders for Coal," to be sent to the undersigned not later than the 22nd inst.

The Directors do not bind themselves to accept the lowest or any Tender.

J. H. BRODIE,
Secretary.

Main Street, Keswick,
June 2, 1904.

THE Directors of the Keswick Gas Company invite TENDERS for their surplus TAR and AMMONIACAL LIQUOR, for Twelve Months from the 30th inst., at per ton delivered into Contractor's Tanks at Keswick Railway Station.

Sealed Tenders, endorsed "Tenders for Tar or Liquor," will be received by the undersigned on or before Wednesday, the 22nd inst.; but the Directors do not bind themselves to accept the highest or any Tender.

J. H. BRODIE,
Secretary.

Main Street, Keswick,
June 2, 1904.

LONGFORD GAS COMPANY, LIMITED, IRELAND.

THE Directors invite Tenders for the supply of all MATERIAL including IRON WORK, and all Labour required in the erection of a BENCH of Six RETORTS, at their Works.

Full Particulars can be obtained from the undersigned, to whom Tenders may be sent not later than the 2nd post on Thursday, the 23rd day of June, 1904.

W. E. YOUNG,
Secretary and Manager.

June 10, 1904.

TO COAL MERCHANTS, SHIP OWNERS, AND OTHERS.

THE Directors of the Torquay Gas Company are prepared to receive TENDERS for the supply of about 14,000 Tons (or such other quantity as may be agreed on) of best approved GAS COALS.

Tenders to state the price of the Coals, and the freight to Dartmouth or Torquay, separately and together, and also for delivery into the Company's Works, adjoining the Great Western Railway, free of all charges.

Further Particulars and Forms of Tender may be obtained from Mr. Beynon, the Manager of the Company, Hollacombe, Paignton, and Tenders are to be sent to the undersigned before the 27th day of June inst.

JOHN KITSON,
Secretary.

Torquay, June 10, 1904.

BOROUGH OF EVESHAM.

(GAS DEPARTMENT.)

TENDERS FOR GAS COAL.

THE Evesham Corporation invite TENDERS for the supply of from 1000 to 2000 Tons (or less if required) of best screened GAS COAL, during the Year ending the 30th of June, 1905, to be delivered on rail at Evesham.

Tenders, to be sent to me not later than the 28th day of June inst., to include full Description as to Coal and Price.

No Form of Tender supplied.

The Corporation do not bind themselves to accept the lowest or any Tender.

THOS. A. COX,
Town Clerk.

Town Clerk's Offices,
Evesham, June 8, 1904.

COUNTY BOROUGH OF OLDHAM.

THE Oldham Corporation Gas-Works Committee invite TENDERS for complete installations of,

COAL BREAKING and ELEVATING PLANT.
INCLINED RETORTS.
HORIZONTAL RETORTS.
STOKING MACHINERY (Compressed Air).
do. Projector Type.

Copies of Specifications may be obtained from the General Manager, Mr. Arthur Andrew, on payment of One Guinea for each Specification, which sum will be returned if a *bonâ-fide* Tender is submitted.

Plans may be inspected at the Offices in Greaves Street after June 20.

Tenders to be sent to Mr. A. Andrew, Gas Offices, Oldham, on or before Tuesday, July 6, 1904.

J. H. HALLSWORTH,
Town Clerk.

Oldham, June 9, 1904.

COUNTY BOROUGH OF HALIFAX.

THE Gas-Works Committee of the Halifax Corporation invite TENDERS for the supply of: (1) BRASS LAMP FITTINGS, (2) BRASS MAIN COCKS and UNIONS, (3) OXIDE OF IRON, (4) SULPHURIC ACID, (5) LIME, (6) GAS OIL; and for the Purchase of: (1) BRIMSTONE, (2) GAS CARBON, (3) SPENT OXIDE OF IRON, during the Twelve Months ending June 30, 1905.

Forms of Tender and further Information may be obtained on application to Mr. J. Wilkinson, F.C.S., Engineer, Gas-Works, Halifax.

Tenders, properly endorsed, must be sent to the undersigned not later than Twelve o'clock noon on Friday, June 24, 1904.

The persons whose Tenders are accepted for the supply of the above-mentioned articles will be required to observe the Fair Contracts Clauses adopted by the Corporation.

By order,
KEIGHLEY WALTON,
Town Clerk.

BRIERLEY HILL DISTRICT GASLIGHT COMPANY.

TENDERS FOR TAR.

THE Directors invite Offers for the surplus TAR made at their Brierley Hill and Kingswinford Works, to be taken between July 1 next and June 30, 1905, delivered into Buyers' Boats.

The Directors do not bind themselves to accept the highest or any Tender.

Tenders, to be addressed to the Chairman, endorsed "Tender for Surplus Tar," not later than June 24, 1904.

HENRY M. JACKSON,
Secretary.

Board-Room, Gas-Works,
Brierley Hill, June 1, 1904.

READING GAS COMPANY.

TAR.

THE Directors of the Reading Gas Company invite TENDERS for the purchase of their surplus TAR for One Year, commencing on the 1st of July next.

Specifications for the Contract will be forwarded on application to the Engineer and Manager (Mr. Douglas H. Helps).

Railway communication direct to the Works.

Tenders, endorsed, "Tender for Tar," and addressed to the undersigned, must be delivered not later than Monday, June 20, 1904.

A. CANNING WILLIAMS,
Secretary.

7, King Street, Reading,
May 31, 1904.

COUNTY BOROUGH OF BURY

COALS.

THE Gas Committee are prepared to receive TENDERS for the supply of the following COALS:—

40,000 Tons (approximately) of	GAS COAL.	
300	"	BURGY.
300	"	HOUSE COAL.

Forms of Tender and Conditions of Contract may be obtained on application to Mr. H. Simmonds, Engineer and Manager, Gas-Works, Bury.

Tenders, endorsed "Gas Coal," to be sent to the office of the undersigned not later than Saturday, the 18th inst.

JOHN HASLAM,
Town Clerk.

Municipal Offices, Bury.
June 1, 1904.

BOROUGH OF SMETHWICK.

TENDERS FOR GAS COAL AND CANNEL.

THE Gas Committee invite Tenders for the supply of about 30,000 Tons of GAS COAL and NUTS, and 1000 Tons of CANNEL, for delivery during the Year ending the 30th of June, 1905.

Form of Tender and further Information may be obtained of the undersigned.

Sealed Tenders, endorsed, and addressed to the Chairman of the Gas Committee, Town Hall, Smethwick, to be sent in not later than the 23rd of June inst.

The Committee do not bind themselves to accept the lowest or any Tender.

By order,
W. J. STURGES,
Secretary.

Gas Offices, Town Hall, Smethwick,
June 2, 1904.

GAINSBOROUGH URBAN DISTRICT COUNCIL.

(GAS DEPARTMENT.)

TENDERS FOR GAS COAL.

THE Gas Committee of the above Council invite TENDERS for the supply of 6000 Tons of best GAS COAL (Screened, Unscreened, or Nuts), to be delivered at the Great Central Railway Station, Gainsborough, between the 1st of July, 1904, and the 30th of June, 1905, in such quantities, monthly, as may be required.

Sealed Tenders, endorsed "Tender for Gas Coal," giving full Particulars of the Coal offered, to be addressed to the Chairman of the Gas Committee, must be delivered at the Gas-Works, Gainsborough, not later than the 23rd inst.

No special Form of Tender issued.

The Committee do not bind themselves to accept the lowest or any Tender.

JOHN BALDWIN,
Manager.

Gas-Works, Gainsborough,
June 4, 1904.

BRIDGNORTH CORPORATION GAS-WORKS.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Gas Committee are prepared to receive sealed TENDERS for the supply of GAS COAL, including carriage to the Bridgnorth Railway Station, for One Year from, or soon after, the end of July next.

Evidence as to the quality of the Coal must accompany each Tender.

Quantity required: About 2300 Tons to 2600 Tons, in proportionate deliveries as directed—say, 70 per cent. during Winter Months, and 30 per cent. during Summer Months.

Sealed and marked Tenders must be sent to the undersigned not later than Thursday, the 16th of June.

The Committee reserve to themselves the right to divide the quantity into two or more Contracts, and do not bind themselves to accept the lowest or any Tender.

Official Forms for Tender are not furnished.

By order,
J. H. COOKSEY,
Town Clerk, Secretary.

Bridgnorth,
May 27, 1904.

TAR Contracts Wanted on the Sliding-Scale or at Fixed Prices.

Managers and Secretaries desirous of selling to best advantage please communicate with DENT AND CO., Ouse Chemical Works, SELBY.

MASTERTON (N.Z.) CORPORATION GAS-WORKS.

TENDERS are invited for Two New PURIFIERS 10 or 12 feet square by 4 or 5 feet deep, without Grids, with 8-inch Connections and Single Valves to each Inlet and Outlet.

Apply, giving full Particulars and stating Price either c.i.f. Wellington (N.Z.) or f.o.b. London, to

DOUGLAS DOBSON, Assoc.M.Inst.C.E., Manager.

GAS TAR.

THE Urban District Council of Atherton invite TENDERS for the purchase of the TAR produced at their Gas-Works during Twelve Months from the 30th of June inst.

Probable quantity about 400 Tons.

Sealed Tenders to be delivered to the undersigned on or before Wednesday, the 22nd. inst.

D. SCHOFIELD, Clerk.

HORNSEY GAS COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of this Company, relating to DEBENTURE STOCK ONLY, WILL BE CLOSED on the 16th inst., and RE-OPENED on the 1st of July, 1904.

By order of the Board,
WILLIAM E. ROBERTS, Secretary.

63, Chancery Lane, W.C.,
June 15, 1904.

TOTTENHAM AND EDMONTON GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of the Company, so far as they relate to DEBENTURE STOCK, WILL BE CLOSED at Ten o'clock forenoon on Friday, the 17th of June, for the Half Year ending June 30, 1904, and will be RE-OPENED on Friday, the 24th of June.

The Interest for the Half Year will be payable on the 1st day of July next to the Proprietors registered on the closing of the Books.

By order of the Board,
JAMES RANDALL, Secretary.

Chief Offices: 639, High Road,
Tottenham, June 10, 1904.

EAST LONDON WATER-WORKS COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS in respect both to the Four-and-a-half per Cent. and the Three per Cent. Debenture Stocks, WILL BE CLOSED from the 14th to the 30th of June inst., both days inclusive, and RE-OPENED on the 1st of July, on which day the Interest Warrants on these Stocks will be payable by the Metropolitan Water Board.

On and after Friday, the 24th inst., all business relating to the above Debenture Stocks will be transacted at the offices of the Metropolitan Water Board, Caxton Hall, Westminster.

By order,
I. A. CROOKENDEN, Secretary.

St. Helen's Place,
Bishopsgate Street, E.C.,
June 7, 1904.

By order of the Executors.

REIGATE GAS COMPANY.

£2130 ORDINARY STOCK and 119 £10 SHARES (£5 paid).

MAPLE & CO. have received Instructions from the Executors of the late Richard Kelsey, Esq., to SELL the above BY AUCTION, at Laker's Hotel, Redhill, on Wednesday, June 22, 1904, at Six o'clock.

Particulars of the AUCTIONEERS, 109, King's Road, BRIGHTON, LONDON, and EASTBOURNE.

By order of the Executors.

EAST SURREY WATER COMPANY.

£4250 PREFERENCE STOCK.

MAPLE & CO. have received instructions from the Executors of the late Richard Kelsey, Esq., to SELL the above BY AUCTION, on Wednesday, June 22, 1904, at Six o'clock.

Particulars of the AUCTIONEERS, 109, King's Road, BRIGHTON, LONDON, and EASTBOURNE.

Just Published. Crown 8vo, 6s. Cloth.

GAS-WORKS

THEIR

CONSTRUCTION AND ARRANGEMENT

And the Manufacture and Distribution of Coal Gas.

By S. HUGHES, C.E.

Ninth Edition, Revised, with Notices of Recent Improvements.

By HENRY O'CONNOR, A.M.Inst.C.E., Author of the "Gas Engineer's Pocket Book."

LONDON: CROSBY LOCKWOOD & SON, 7, STATIONERS' HALL COURT, E.C.

ISSUES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his ISSUES by AUCTION under PARLIAMENTARY POWERS of STOCKS and SHARES in LONDON, SUBURBAN, and PROVINCIAL GAS and WATER COMPANIES take place PERIODICALLY at the Mart, TOKENHOUSE YARD, E.C.

Terms for Issuing such Capital, and also for including Gas and Water Stocks and Shares belonging to Private Owners in these Periodical Sales, can be obtained on application at MR. ALFRED RICHARDS' OFFICES, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the

BARKING GAS COMPANY.

NEW ISSUE OF £6000 FOUR PER CENT. PERPETUAL DEBENTURE STOCK.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, June 21, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By Order of the Directors of the

MAIDENHEAD GAS COMPANY.

NEW ISSUE OF £4000 CONSOLIDATED ORDINARY STOCK.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, June 21, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By Order of the Directors of the

ALDERSHOT GAS AND WATER COMPANY.

NEW ISSUE OF 350 £10 FIVE PER CENT. "G" PREFERENCE SHARES AND 350 £10 "G" ORDINARY SHARES.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart., E.C., on Tuesday, June 21, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By Order of the Directors of the

ASCOT DISTRICT GAS COMPANY.

NEW ISSUE OF £4000 FOUR PER CENT. PERPETUAL DEBENTURE STOCK.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, June 21, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By Order of the Directors of the

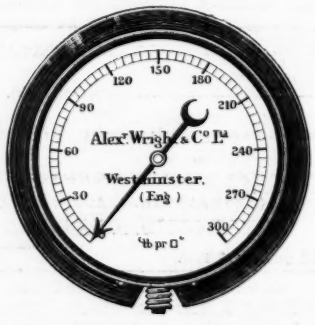
NORTH MIDDLESEX GAS COMPANY.

NEW ISSUE OF £3300 FOUR PER CENT. PERPETUAL DEBENTURE STOCK.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, July 5, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

STEAM, OIL, and WATER.



Any Range of Pressure.

ROBERT MARSHALL,

CANNEL COAL MERCHANT,

97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on Application.

SAVE MONEY LABOUR

Imperial Cookers give no trouble, and for quality and cheapness cannot be excelled.

TWO GOLD MEDALS in Six Months.

Our Gas-Cooker Orders last Year were

455 % (per cent.)

more than in 1902.

THE IMPERIAL STOVE CO., LEAMINGTON SPA.

Telegrams: "Imperial, Leamington."
Telephone: One X.

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD

BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.

RAVENSTHORPE, NEAR DEWSBURY.

THE

PETROLEUM GAS SYNDICATE

Supply and erect Complete Installations of their

PETROGENE PATENT GAS PLANT

On SALE, HIRE, or ROYALTY.

PETROGENE GAS is the most suitable Illuminant for all Towns, Villages, Factories, Institutions, &c., where a Cheap and Efficient Lighting System is required. It is equally suitable for Heating and Power purposes, and may be used with ordinary Gas Fittings, Stoves, Engines, &c. It may also be used in conjunction with Coal Gas, and affords Gas Companies a ready means of increasing their output without the expense of additional storage.

The Syndicate is prepared to entertain offers of sale of small Gas-Works, whether profit earning or not.

Offices: **28, Victoria St., Westminster.**
Works: **10, Rochester Row, S.W.**

HEATHCOTE GAS COAL.

Rich in Illuminating Power and yield of Gas.

Above the Average in Weight and Quality of Coke.

Maintains a High Standard in Residuals.

THE GRASSMOOR CO., LD.,

CHESTERFIELD.

THE

"ROTARY"

STATION METER.

Efficiency Demonstrated.

APPLY—

T. G. MARSH,

MAWSON CHAMBERS, DEANSGATE, MANCHESTER.

TROTTER, HAINES, & CORBETT, LIMITED,
Brettell's Estate
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Special Lumps, Tiles, and Bricks for Regenerative and Furnace Work.
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

LONDON OFFICE: R. CULL, 34, OLD BROAD STREET, E.C.

PRICE'S COKE & COAL BARROW

effects a great saving of time, labour, and expense.

For Particulars, Price, &c., apply to Mr. EDWARD PRICE, "Langley," Wyke Avenue, WORTHING.

NEWBATTLE CANNEL.
Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO
THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

JAMES OAKES & CO.,
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.,
Manufacture and keep in Stock at their Works (also large stock in London)
PIPES and CONNECTIONS, 1½ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS, and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with Bolts, Nuts, and Covers, and rendering Leakage impossible.

EDWIN LEWIS & SONS,
BRITANNIA & PATENT TUBE WORKS,
WOLVERHAMPTON,
LONDON & LIVERPOOL.

E. L. & S.
TUBES & FITTINGS.

RAILS.
New and Second-Hand with all Accessories; also Tip Waggons and Turntables.

B. M. RENTON,
MIDLAND WORKS,
SHEFFIELD.

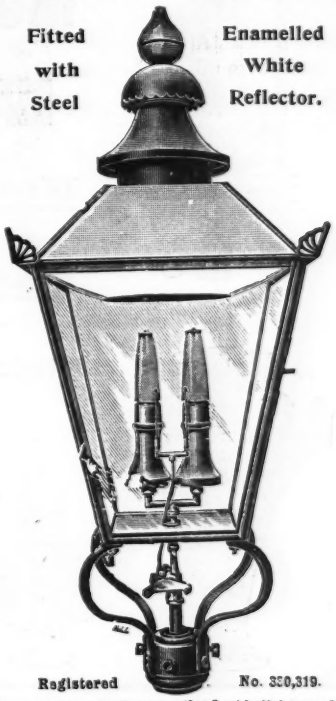
THOMAS TURTON AND SONS, LIMITED,
SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS,
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
LONDON OFFICE:
90, CANNON STREET, E.C.

THOMAS DUXBURY & CO.,
16, DEANSGATE, MANCHESTER.
Best Gas Coal and Cannel, giving High Illuminating Power, Large Yield per ton, and reasonable in Price.
Telegrams: "DARWINIAN, MANCHESTER."
Telephone 1806.

THE
"KILBURN" LANTERN.

Fitted with Steel

Enamelled White Reflector.



Registered No. 330,319.

The "Kilburn" Lantern (for double lights) and the "St. Albans" Lantern have been adopted for lighting the Town of St. Helens.

H. GREENE & SONS, Limited,
Surrey Engineering Works,
Blackfriars Road, LONDON.
Telephone 1693 HOP.
Telegrams: "LUMINOSITY LONDON."

JAMES MILNE & SON, LTD.,
GAS ENGINEERS
MILTON HOUSE WORKS EDINBURGH.
LONDON. —— LEEDS. —— GLASGOW.

NOW READY, pp. 584 & XVI. 251 ILLUSTRATIONS. F'CAP. QUARTO, PRICE 18s. NET (POST FREE).

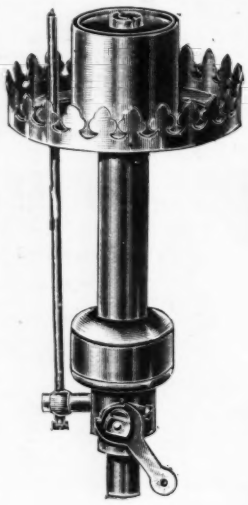
THE SEVENTH EDITION OF

NEWBIGGING'S HANDBOOK
FOR
GAS ENGINEERS & MANAGERS
(DEDICATED TO SIR GEORGE LIVESEY).

The Work has been revised throughout, and contains 40 pages of Letterpress and 12 Illustrations more than the last Edition.

In almost every department additions have been made; and it is believed that the labour bestowed on its production will enhance the value of the book as a Work of Reference.

Orders may be sent through any Bookseller, or direct to the Publisher, WALTER KING, Office of the "Journal of Gas Lighting," &c., 11, BOLT COURT, FLEET STREET, LONDON.



GENERAL HEATING & LIGHTING Co., Ltd.
(MOELLER'S SYSTEM),
26, VICTORIA STREET, LONDON, S.W.

MOELLER'S BURNERS.

MAINTENANCE SIMPLIFIED

— BECAUSE —

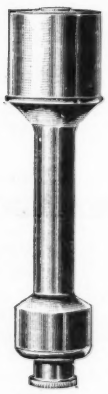
Nothing to Corrode,
Nothing to Choke,
Nothing to Get Out of Order.

Made in 4 sizes, consuming 3, 4, 4½, and 6½ feet respectively.

THE MOST ECONOMICAL FOR STREET LIGHTING.
THE MOST SUITABLE FOR PRIVATE LIGHTING. . .

SUPPLIED IN BRASS OR NICKELLED.

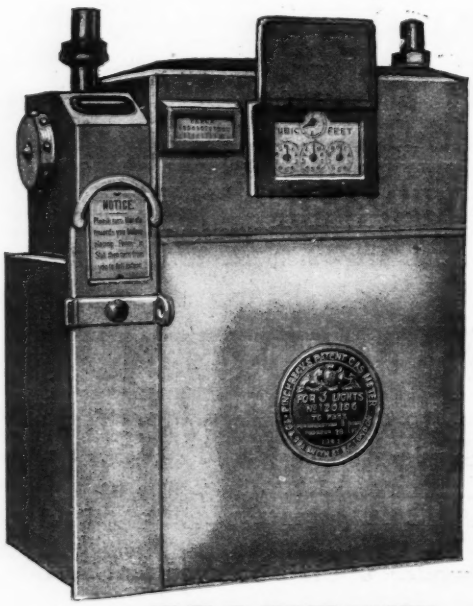
PRICE LIST ON APPLICATION.



J. PINCHBECK

ESTD 1844.

Wet and Dry Gas Meter Manufacturer.



ALL METERS HAND-MADE
WITH BEST MATERIALS
AND
WORKMANSHIP.

AUTOMATIC METERS A SPECIALITY.

PRICES FREE ON APPLICATION.

NOTICE OF REMOVAL

From SMITH STREET, CLERKENWELL, to

ADAMS PLACE, GEORGE'S RD., HOLLOWAY, N.

THE 'CAXTON'

IS ON TOP OF ALL OTHER

STREET LANTERNS

AS IT IS

STRONGEST,

CHEAPEST,

And the Life of the Mantle is twice as long as any other make.

LAMPS FOR EVERY KNOWN PURPOSE.

SEND FOR ESTIMATES AND CATALOGUES.

EDGAR'S SYSTEM

OF

INDUCED CURRENT, LOW PRESSURE LIGHTING

Will interest you. Send for Details.

Telephone— 14 Hammersmith. **W. EDGAR,** Telegrams— "Gasoso" London.

BLENHEIM LAMP WORKS,

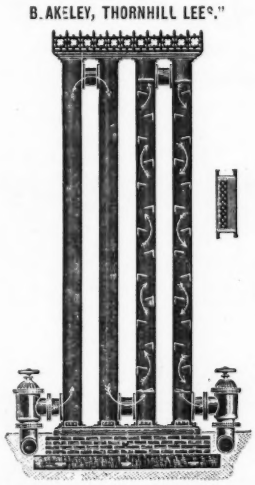
HAMMERSMITH.

J. FIRTH BLAKELEY & CO.,

Telegrams:— B. AKELEY, THORNHILL LEE."

Gas Engineers and Contractors,

THORNHILL, DEWSBURY.



"BLAKELEY'S"

Patent Rectangular Vertical

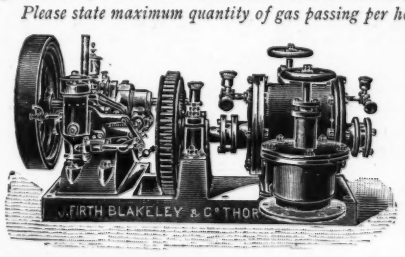
CONDENSERS,

Having Perforated Baffle Plates with Water-spreading and Cooling Arrangement.

These Condensers are already in use at several Gas-Works, and are giving every satisfaction.

QUOTATIONS, WITH FULL PARTICULARS AND DRAWINGS, SENT ON APPLICATION.

Please state maximum quantity of gas passing per hour, when enquiring.



'BLAKELEYS' IMPROVED COMBINED GAS ENGINE AND EXHAUSTER,

Specially designed to meet the requirements of small Gas-Works.

NO STEAM BOILER REQUIRED.
WEAR AND TEAR REDUCED.
MORE GAS OBTAINED FROM EACH TON OF COAL.

Full Specification, Drawings, and Quotations on application.

SLOT GOVERNOR BURNERS

(Hawkins and Barton's Patent).

Give Excellent Results and no Trouble.

1093, 6s. per doz. 1095, 7s. per doz. 1094, 7s. per doz. 1096, 6s. per doz.

SUBJECT TO DISCOUNT.

GAS APPARATUS CO., PETERBOROUGH, ENGLAND.

STARTLING INVENTION!

Carborundum Bricks, Carborundum Crucibles, &c.

DR. ENGELS' PATENT

CARBORUNDUM COATINGS

For Lining **GAS-GENERATORS.**

For Lining and Repairing **GAS-RETORTS.**

For Metallurgical and Chemical purposes, Furnaces, and Firing Plants of all kinds.

The Fire-Proof Products Co., Ld.

Representative: **Richard Cremer,**

CIVIL ENGINEER, WOODHOUSE LANE, LEEDS.

BEST & LLOYD

MAKERS OF THE **BIRMINGHAM** Limited,

PATENT "SURPRISE" PENDANT,

WITH PATENT SHADE.

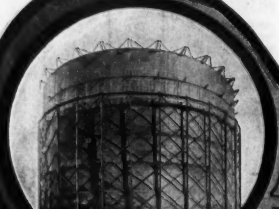
OVER 50,000 NOW IN DAILY USE.

The ONLY GAS-PENDANT suitable for Domestic Lighting; a room 18 ft. by 14 ft. being beautifully illuminated with one Incandescent Burner.

Used in the private apartments of their **Majesties the King and Queen** *at Sandringham.*

ON ADMIRALTY & WAR OFFICE LISTS.

Clayton Son & Co. Ld.



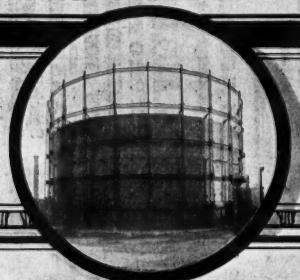
THE LARGEST GASHOLDER IN THE WORLD.

ESTABLISHED 1864.

WORKS, LEEDS.

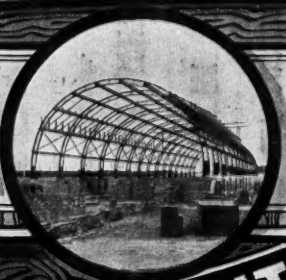
ORIGINAL MAKERS OF SPIRAL-GUIDED HOLDERS

MAKERS OF THE
LARGEST GASHOLDER IN THE WORLD,
CAPACITY 12 MILLION CUBIC FEET.
WAS ERECTED AT EAST GREENWICH FOR THE SOUTH METROPOLITAN GAS COMPANY. IT HAS SIX LIFTS 30 FEET DEEP EACH, & IS 300 FEET DIAMETER, ERECTED & COMPLETED WITHIN 12 MONTHS, & IN THE TIME SPECIFIED.



Makers of Gas Plant

of every Description



Roofs, Purifiers &c

GASHOLDERS OUR SPECIALITY.

GASHOLDER WITH LARGEST METAL TANK IN THE WORLD, 242 FT. DIA. 41 FT. DEEP.

LONDON OFFICE,
60, QUEEN VICTORIA ST. E.C.
TELEGRAMS "GAS, LEEDS".

MAKERS OF HIGH-CLASS BOILERS FOR GAS & ELECTRIC LIGHT WORKS, FITTED WITH DEIGHTON'S PATENT CORRUGATED FLUES, THESE FLUES GIVE GREATLY INCREASED HEATING SURFACE, AND ARE SPECIALLY RECOMMENDED FOR HIGH-PRESSURE BOILERS.

NO WIRE ROPES OR SPIRAL GUIDES REQUIRED IN THIS SYSTEM. INFINITELY SAFER & FAR LESS COSTLY THAN ROPES OR SPIRAL GUIDES.

STRUCTURAL STEEL WORK OF EVERY DESCRIPTION.

REGISTERED TRADE MARK "IGNICE."

At a Conference of the Irish Association of Gas Managers, held on August 13th, 1901, at the Mansion House, Dublin, a paper was read by W. A. Reid, Esq., of Longford, the President, in which he said, "It is a recognized fact with Gas Managers that it is in the Retort House that the Dividends are made."

IGNEOUS

RETORT-REPAIRING CEMENT

RENDERS IT PRACTICABLE TO

PASS ALL GAS THROUGH THE METER, ALLOWING NONE TO ESCAPE.

Mr. E. L. READE, Lecturer on Metallurgy, etc., at the Manchester School of Technology, in the course of an address on "Refractory Material," said, amongst other things, that certain substances were peculiarly suitable for patching in Gas-Works Settings, because its contraction was not sufficient to make it detach itself from other substances.

"Difficulties were often found with Cements for Stoppings, and one essential was that it should possess body enough to retain its shape and sufficient fluxing material to cement together the body and cause it to adhere to the Retort."

The above is virtually a complete description of our Igneous Cement. It is second to none and low in price. Before ordering apply to

THE IGNEOUS CEMENTS COMPANY, LIMITED,

Telegraphic Address:
"GUEBRE LONDON."

24, QUEEN VICTORIA STREET, LONDON, E.C.

CASES FOR BINDING
QUARTERLY
VOLUMES OF THE "JOURNAL"
PRICE **2s.** *EACH.*

THE THAMES BANK IRON CO.
UPPER GROUND STREET, LONDON, S.E.
SUPPLY FROM STOCK
CAST-IRON RETORTS
AND ALL KINDS OF GAS-WORKS APPARATUS.
SOCKET-PIPES FOR GAS OR WATER PURPOSES.
FLANGE PIPES FOR STEAM.
Sole Manufacturers of **LYON'S "PATENT" GAS-MAIN SYPHONS.**
AGENTS FOR
ATTERTON'S PATENT APPARATUS for CHARGING RETORTS.

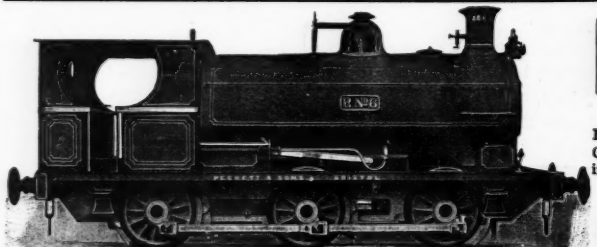
ARROL-FOULIS
Patent Automatic Machinery
FOR
DRAWING AND CHARGING GAS-RETORTS.

Full Particulars may be obtained from the Sole Makers.
SIR WILLIAM ARROL & CO., Limited,
GLASGOW.
[See Illustrated Advertisement, June 6, p. 682.]

WILSON CARTER & PEARSON
LIMITED,
GAS COAL AND CANNEL FACTORS,
Supply to any Railway Station, or for Export, all kinds of Fuel for Gas and Other Purposes.
ADDRESS CHIEF OFFICES:
Temple Buildings, 50, New Street, Birmingham.

LARGEST MANUFACTURERS in the UNITED KINGDOM of GAS-RETORTS,
Horizontal or Inclined; also Makers of Segmental Retorts of all Sections.

PATENTEES OF
Machine-Flanged RETORTS.
DIBDALE WORKS, DUDLEY.
B. GIBBONS, JR., LD.
TELEPHONE DUDLEY NO. 10.
Telegraphic Address: "MACHINE, LOWER GORNAL."
"ABC" Code and UNICODE used for Telegrams and Cablegrams.
SPECIAL BRICKS & BLOCKS of every description for GENERATOR and REGENERATOR FURNACES.
Large Stocks of Bricks of all sizes, Burrs, Boiler Seating Blocks and Covers, Plain and Rebated Tiles, &c., &c.
B. Retorts and other Fire-Clay Goods carefully packed for export.
FOREIGN AND HOME COPIES OF ILLUSTRATED CATALOGUES ON APPLICATION.



LOCOMOTIVES
LOCOMOTIVES of all Sizes and Gauges specially constructed for Main and Branch Lines, Contractors, Docks, Gas-Works, Collieries, Iron-Works, Brick and Cement Works, &c. Locomotives of various Sizes always in Stock, ready for immediate Delivery.
Photographs, Specifications, and Prices on Application.
PECKETT & SONS, Atlas Locomotive Works, **BRISTOL.**
Telegraphic Address: "PECKETT, BRISTOL."

IN EXTENSIVE USE BY THE PRINCIPAL GAS COMPANIES, COLLIERY OWNERS, COAL MERCHANTS, CONTRACTORS, &c., AT HOME AND ABROAD.

HONE'S PATENT GRABS
AUTOMATIC, EFFICIENT, AND ECONOMICAL.
Applicable to any Ordinary Single or Double Chain Crane.
SOLE MANUFACTURERS—
The Thames Iron Works, Shipbuilding and Engineering Co., Ltd., Canning Town, London, E.
Telephone: 526a, EASTERN. *Telegrams: "THAMES, LONDON."*
These Grabs are constructed of various types for dealing with Coal, Coke, Ballast, Sand, Chalk, Grain, Macadam, Ores, and other materials, also for work under water, effecting in every case very substantial saving.
Prices and particulars on application with details of requirements.

A Word to Architects & Builders.

WHY

FIT KITCHENS WITH COAL OVENS

WHEN

TENANTS DESIRE GAS OVENS?

The Old Style.

As soon as the Tenant enters into possession of the house, he makes application to the Gas Office to supply a Gas Oven. The Coal Oven which the Landlord has bought and paid for he does not use; and willingly pays the extra rental to the Gas Department for the comfort and convenience of a Gas Cooker.

The Landlord has sunk capital in purchasing the **wrong** article, and the Gas Department has to sink further capital to supply the **right** article.

Combination Gas & Coal Range

Gas Oven with Griller and Boiling Rings.

Usual Open and Close Fire and Pressure Boiler.

The New Style.

In future, kitchens will be fitted with the Combination Gas and Coal Range, shewn in illustration. The Tenant will then be saved all trouble, and the Gas Department needless outlay of capital. Further, and most important, the Gas Oven will no longer obstruct the valuable kitchen floor space, and the smell of Gas and Cooking will be carried, as is intended, into the chimney. There will be no unpleasant cleaning of oven flues.

In the summer the Gas Oven will do all the work, and coal fires will be unnecessary; and all this can be secured at a small additional cost compared with old Coal Range.

Gothic Iron Works - FALKIRK
26, West Nile Street - GLASGOW
49, Queen Victoria St. LONDON

R. & A. MAIN, LTD.,

Gas Engineers and Ironfounders.

132, Corn Exchange Buildings - - MANCHESTER
58, Broad Street - BIRMINGHAM
23, Bath Street - BRISTOL

Write for Prices. **Special Quotations for Quantities.**

The Earliest Cooker Made.—The 'Eureka'

The Newest Cooker Made.—The New Century 'Eureka'

"EUREKA"

First all the Time.

JOHN WRIGHT & CO., Essex Works, BIRMINGHAM.

Andrew Stephenson,

Tel. Address:
"VOLCANISM, LONDON."

182, Palmerston House,
Old Broad Street,
LONDON, E.C.

TELEGRAMS, "UNBEATEN," BIRMINGHAM.

TELEPHONE No. 815.

GAS, WATER & STEAM TUBES AND FITTINGS

THE STAFFORDSHIRE TUBE CO. LTD.

HEAD OFFICE Edmund Street, BIRMINGHAM

COAL TAR PRODUCTS.

Benzol, Toluol, Solvent Naphtha, Creosote Oils, Grease Oils, Carbolic Acid, Crude Creosote Salts, Granulated (Crude) Naphthalene, Sublimed Naphthalene, Anthracene, Refined Tar, Pitch, also Sulphate of Ammonia.

For Prices apply to the **SOUTH METROPOLITAN GAS COMPANY,**

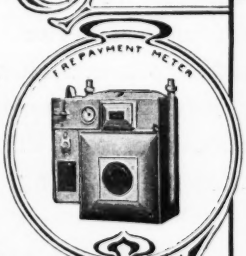
Works: ORDNANCE WHARF, EAST GREENWICH, LONDON, S.E.

709, OLD KENT ROAD, LONDON, S.E.

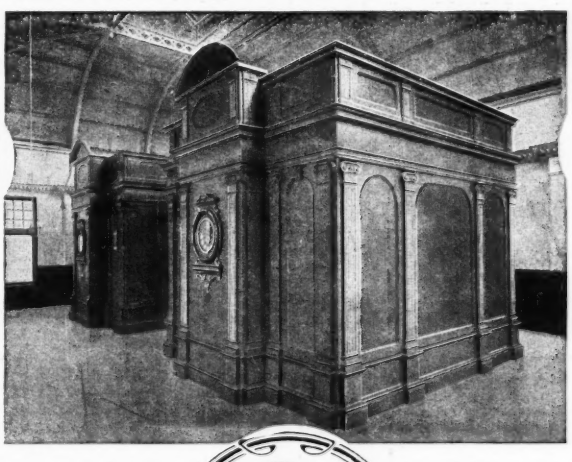
Telegraphic Address: "METROGAS, LONDON."

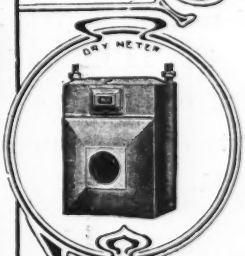
R. LAIDLAW & SON, LIMITED

GAS & WATER ENGINEERS,



SIMON SQUARE WORKS, EDINBURGH.





6 LITTLE BUSH LANE, LONDON, E.C.

TWO STATION METERS EACH TO PASS 200000 CUB. FT. PER HOUR. ERECTED AT THE ALLIANCE FOUNDRY & ENGINEERING WORKS. GLASGOW.

GRANTON GAS WORKS FOR THE EDINBURGH & LEITH GAS COMMISSIONERS.

B. GIBBONS, JUNR.,

LIMITED,

DIBDALE FIRE-CLAY WORKS,

Telegraphic Address:
"MACHINE,
LOWER GORNAL."

DUDLEY.

Telephone:
No. 10
DUDLEY.

The Largest Manufacturers in the Kingdom of

MACHINE-MADE GAS-RETORTS.

Patentees of

MACHINE-MADE FLANGES

By our process the Flange of the Retort can be made in the MACHINE at the same time as the Body, the whole being then of one consistency, which has great advantages over the process of Flanging by hand.

MACHINE-MADE SLOPERS

TAPERED OR PARALLEL.

By our improved methods we make these retorts perfectly smooth on the Interior. The Die for making Tapered Retorts mechanically expands as the Retort is made, thus ensuring a perfectly gradual increase of area, which is almost impossible with hand moulding.

MAKERS OF

REGENERATIVE TILES OF EVERY WELL-KNOWN SYSTEM.
LARGE STOCKS OF ORDINARY FLUE COVERS, BURRS,
BOILER-SEATING BLOCKS,
RABBETTED AND PLAIN TILES, HAND MOULDED AND
PRESSED BRICKS OF ALL DESCRIPTIONS.

QUOTATIONS SENT ON APPLICATION.

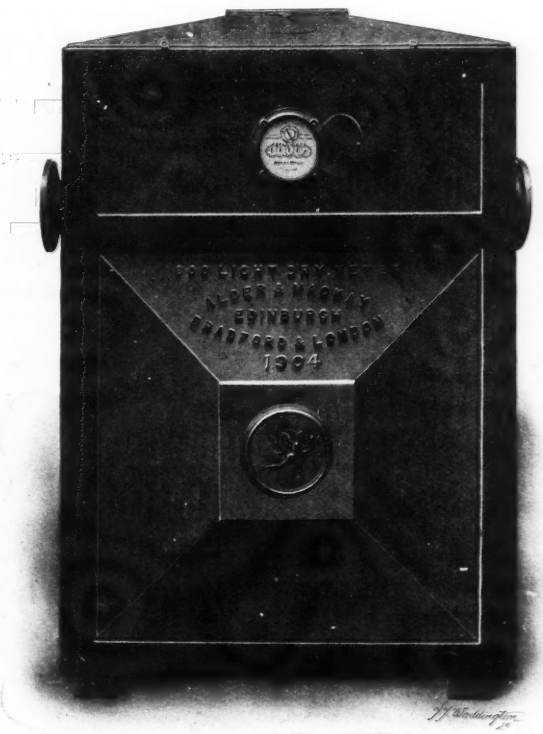
ALDER & MACKAY.

— ESTABLISHED 1850. —

Manufacturers of

WET AND DRY ORDINARY AND PREPAYMENT GAS METERS.

Unsurpassed for Accuracy and Reliability.



SPECIALISTS IN SLOT METERS.

Original Makers of DRY METERS IN CAST IRON CASES.

. . . Sole Makers of . . .

GREEN'S PATENT UNDERGROUND WET METERS.
STATION METERS. EXPERIMENTAL METERS.
DEMONSTRATION METERS. PRESSURE GAUGES.

FULL PARTICULARS AND PRICES ON APPLICATION.

New Grange Works,
EDINBURGH.
Telegrams: "ALDER, EDINBURGH."
Telephone: 1481 CENTRAL.

Ventnor Street Works,
BRADFORD.
Telegrams: "ALDER, BRADFORD."
Telephone: 1222.

13, Victoria St., Westminster,
LONDON.
Telegrams: "ALDERUGI, LONDON."

JOHN BROWN & CO., LTD., SHEFFIELD,

Proprietors of

ALDWARKE MAIN, CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.

ALDWARKE MAIN GAS COAL

Analysis: 12,600 Feet of 19-Candle Gas per Ton.

Value in Pounds of Sperm, 820·20.

VERY FREE FROM IMPURITIES.

TELEGRAMS: "ATLAS, SHEFFIELD."

D. HULETT & CO., LTD.

55 & 56, High Holborn, London.

GAS SERVICE CLEANSERS.

LAMP TORCHES.

DRY GAS-METER MAKERS.

WROUGHT-IRON TUBES & FITTINGS

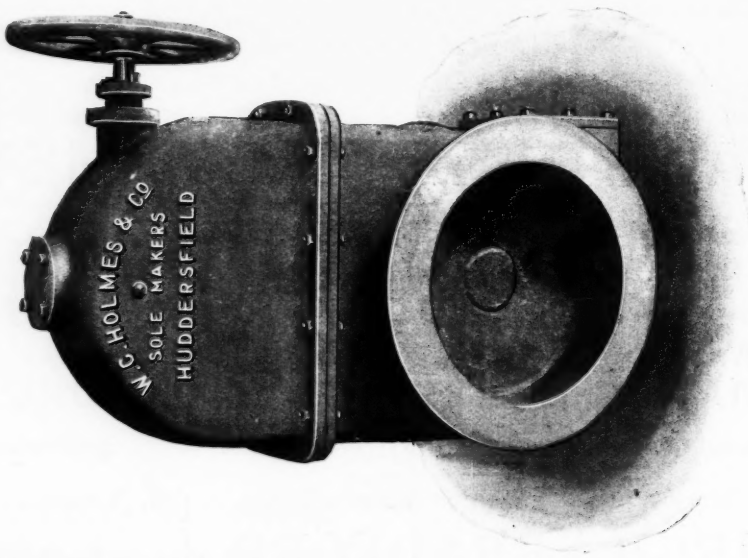
STREET LAMPS & POSTS.

PRICE LISTS ON APPLICATION.

DOUBLE FACED VALVES

"WESTERN" TYPE,

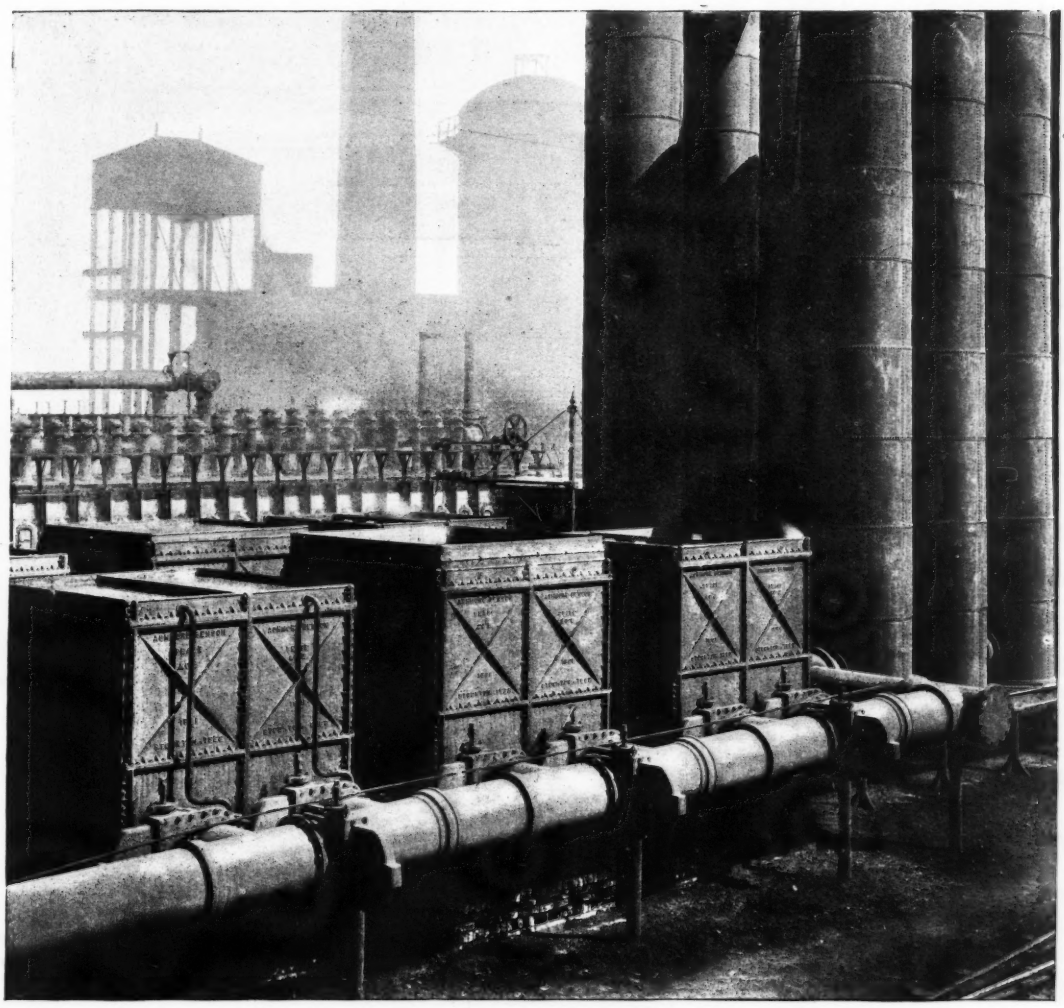
MADE IN HORIZONTAL OR VERTICAL FORM from 6 in. to 48 in.



W. C. HOLMES & CO., HUDDERSFIELD.

Condensers

SEND FOR ESTIMATES.



Made and Erected

by

ASHMORE, BENSON, PEASE, & CO., LTD.,

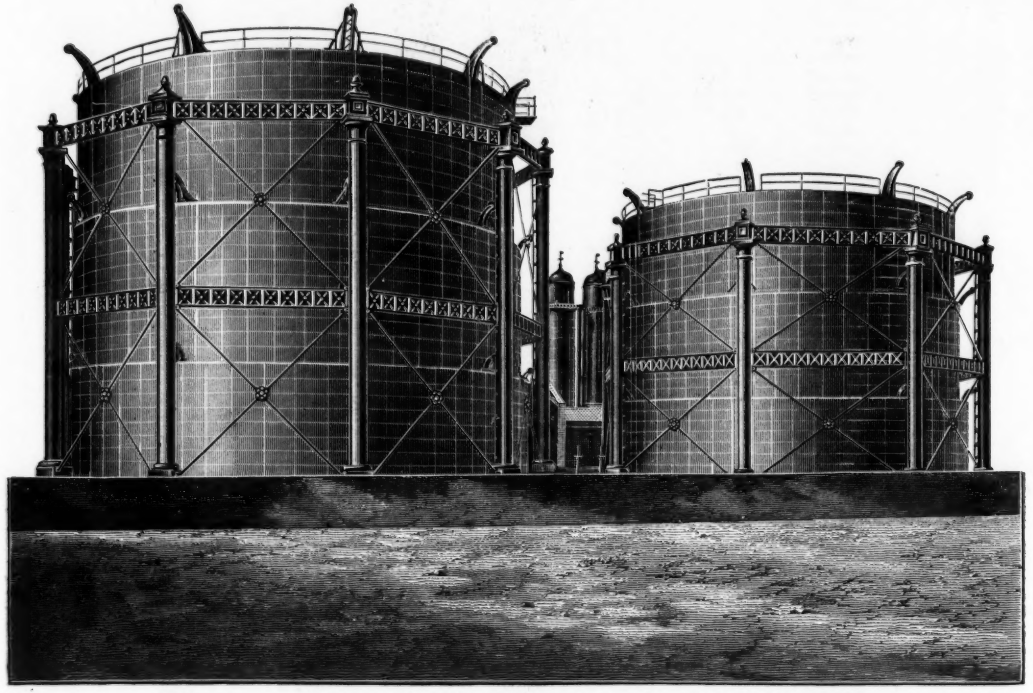
Stockton-on-Tees.

Telegrams:
"GASHOLDER."

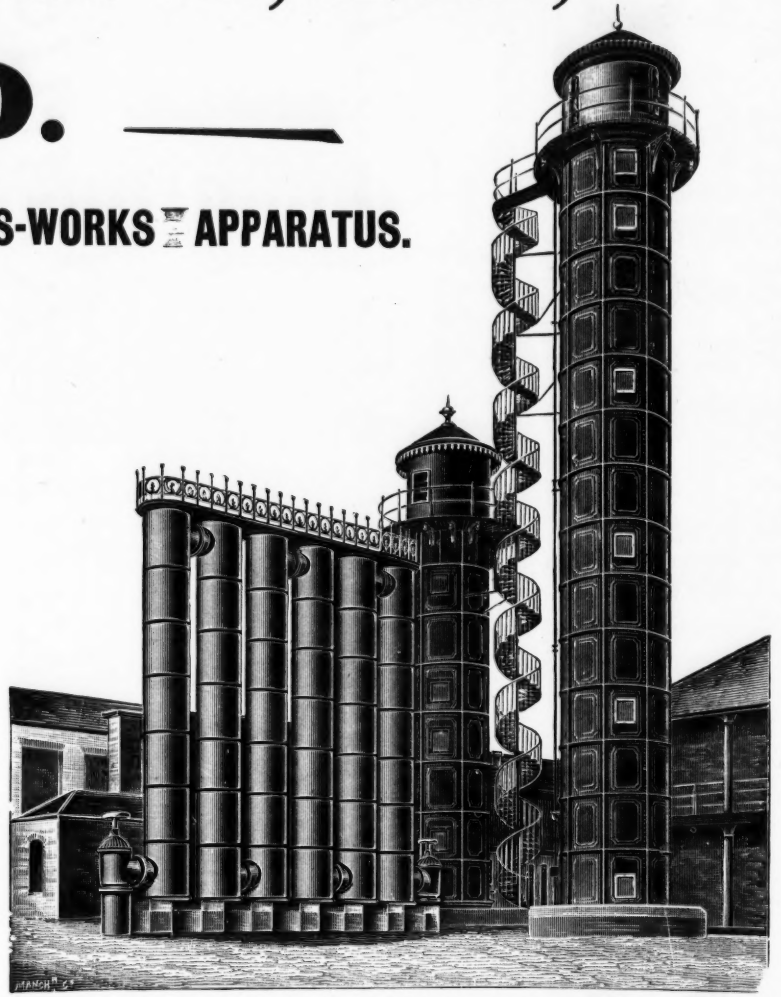
R. DEMPSTER & SONS, Ltd.,

ELLAND.

MANUFACTURERS OF EVERY DESCRIPTION OF GAS-WORKS APPARATUS.



Gasholders.
With Inner Lifts rising above Guide Framing.



Annular Condensers.
Tower Scrubbers.

SUNLIGHT MANTLES.

* * *

Double Woven Cotton

36s. PER GROSS.

Gladiator Ramie,

27s. PER GROSS.

BRITISH MADE THROUGHOUT BY BRITISH LABOUR.

LICENSED BY THE WELSBACH CO. UNDER THEIR PATENT No. 124 OF 1893.

NEW SUNLIGHT INCANDESCENT CO. (1900)
LIMITED,
Palmer St., Westminster, S.W.

TELEGRAMS: "IGNIFLUOUS, LONDON." TELEPHONE: 683 WEST.

THE LEEDS FIRECLAY CO., LTD.

CLIFF'S BRANCH.

LONDON OFFICES & DEPÔTS:

Baltic Wharf, Waterloo Bridge, S.E.
and G.N. Goods Station,
King's Cross, N.

Liverpool: Leeds Street.
Leeds:
Queen Street.

CLIFF'S PATENT
Machine-Made Retorts

Cliff's Patent Machine-Made Retorts possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

Retorts carefully Packed for Export.

Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

THE LEEDS FIRECLAY CO., LTD.

JOSEPH CLIFF & SONS' BRANCH.

Cliff's Wortley Silica Bricks.

FOR Arches and Crowns where high heats are required. They contain over 90 per cent. of Silica, and are nearly stationary under the influence of heat, swelling a little rather than contracting. They are not like a Gannister or Dinas Brick, but a Fire-Brick of a highly Silicious nature.

Cliff's Wortley Aluminous Bricks.

THESE are for Side Walls where great wear and tear takes place. Are made of a specially prepared mixture, are high in Alumina, and are what is termed a HARD FIRE-BRICK.

BALTIC WHARF, WATERLOO BRIDGE, LONDON, S.E.
Liverpool: Leeds Street. Leeds: Queen Street.

THE WIGAN COAL & IRON CO., LIMTD.,

Are exclusive Owners of the well-known HAIGH HALL & KIRKLESS HALL GAS COAL COLLIERIES, and supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, Cannel Nuts, &c.

MIDLAND AND WEST OF ENGLAND DISTRICT OFFICE: *6, CORPORATION STREET, BIRMINGHAM—Sole Agent: A. C. SCRIVENER.*
Telegraphic Address "WIGAN, BIRMINGHAM." Telephone No. 200.

LONDON DISTRICT OFFICE: *6, STRAND, LONDON—C. PARKER & SON, Sole Agents.*
Telegraphic Address: "PARKER LONDON."

GANDY'S BELTING

Holds the World's Record! 41 Prize Awards!

IN A WATER-GAS PLANT, an important item is the Belt for driving the Blower. Ours are specially constructed **Endless Belts,** and have acquired a reputation for this special Work.

CONVEYOR BELTING—A SPECIALITY.

THE GANDY BELT MANUFACTURING COMPANY, LTD.,
HEAD OFFICES AND WORKS—**SEACOMBE, LIVERPOOL.**

This Trade Mark may be seen stencilled on every genuine "Gandy" Belt.

HIGHEST AWARDS—LONDON, PARIS, COLOGNE, VIENNA, MELBOURNE, AND OTHERS.

— 11 MEDALS. —

MANUFACTURERS OF TUBES AND FITTINGS OF EVERY DESCRIPTION.

WROUGHT-IRON OR STEEL MAINS UP TO 6 FEET DIAMETER FOR GAS, WATER, OIL, OR OTHER PURPOSES.

SCREWING TACKLE, BOILER MOUNTINGS, VALVES, COCKS, ETC.

LONDON: 138, Southwark Street. **MANCHESTER:** 33, King Street West. **BIRMINGHAM:** 114, Colmore Row. **LEEDS:** 6, Mark Lane, New Briggate

A Specimen Consignment of

300

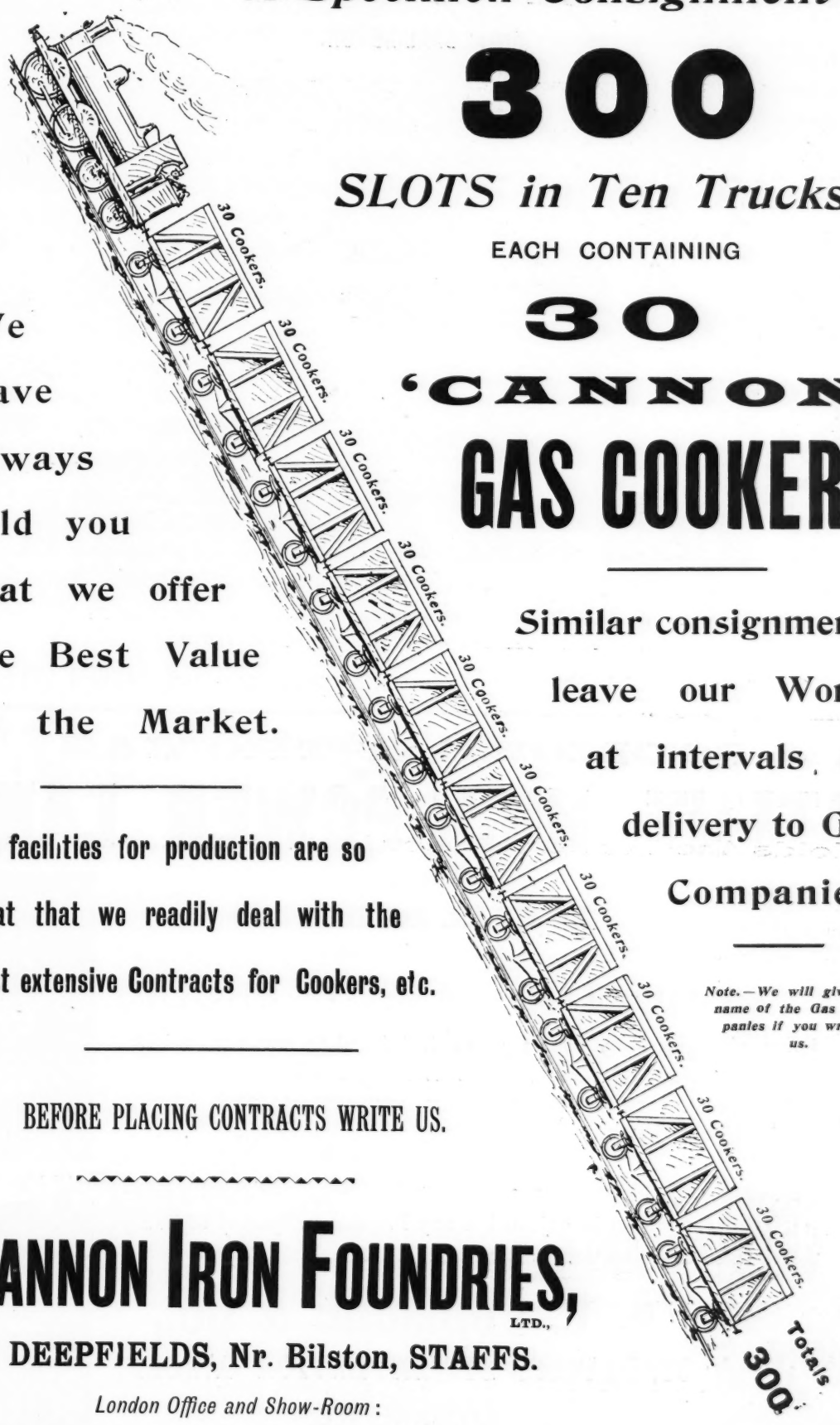
SLOTS in Ten Trucks

EACH CONTAINING

30

'CANNON'

GAS COOKERS



We have always told you that we offer the Best Value in the Market.

Our facilities for production are so great that we readily deal with the most extensive Contracts for Cookers, etc.

Similar consignments leave our Works at intervals for delivery to Gas Companies.

Note.—We will give the name of the Gas Companies if you write to us.

BEFORE PLACING CONTRACTS WRITE US.

CANNON IRON FOUNDRIES, LTD.,

DEEPFIELDS, Nr. Bilston, STAFFS.

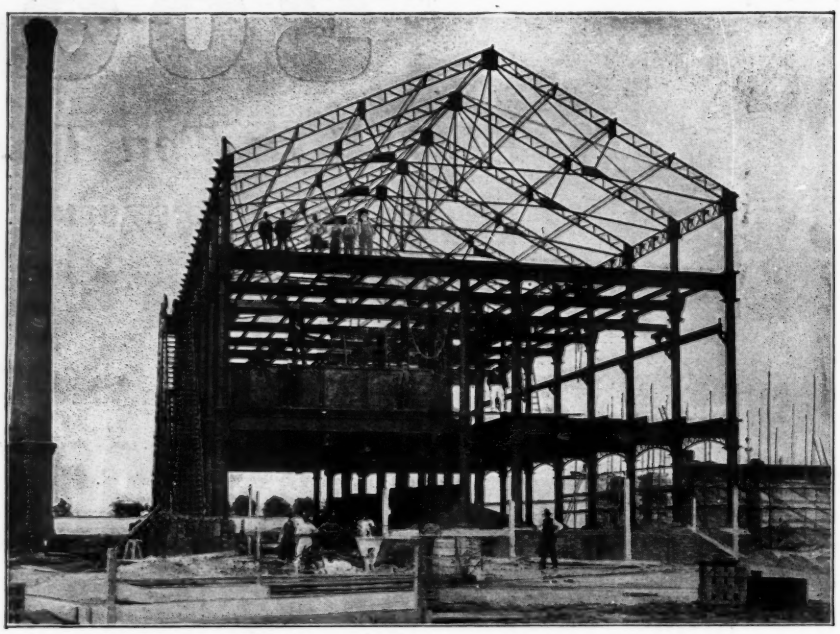
London Office and Show-Room:

BATH HOUSE, 57-60, HOLBORN VIADUCT, E.C.

THE WHESSOE FOUNDRY CO., LTD.

Works: DARLINGTON.

MAKERS OF EVERY DESCRIPTION OF GAS PLANT



GASHOLDERS AND DRY-SEAL PURIFIERS A SPECIALITY.

PHOTO. OF STAGE-FLOOR PURIFIER-HOUSE TAKEN DURING ERECTION FOR THE UNION DES GAZ AT THEIR WORKS NANTERRE, PARIS.

London Office: 106, CANNON STREET, E.C.

PODMORE & THOMAS

PATENT HIGH-POWER LAMP.

No. 12 A. Fig. 3.

OUR

BURNERS

ARE ABSOLUTELY

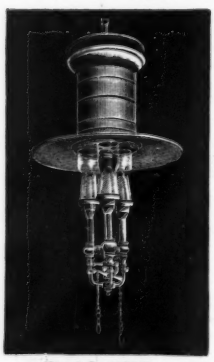
DUST & INSECT PROOF,

strongly made, and well finished to suit any position. And the most suitable Lamp for Gas Companies to Let on the Hire System, and compete with Electric Lighting.

No wearing parts to get out of order.

Can be adjusted to any Pressure or Quality of Gas.

No. 6 B.W. 3-Light.



No. 6 B. 3-Light.

No. 6 A. Fig. 1.

A. E. PODMORE & CO.,

33, CHARLES STREET, HATTON GARDEN, LONDON, E.C.

A.B.C. Code 5th Edition used.

Telephone: 6600 CENTRAL. Telegrams: "PROMEROPE, LONDON."

BOWENS' Ltd. Successors,
STOURBRIDGE.

MANUFACTURERS OF
BEST FIRE-BRICKS; INCLINED, HORIZONTAL, and SECTIONAL RETORTS; LUMPS, TILES, &c., of every description.
ESTABLISHED 1860.

CLAYTON SON & Co LTD LEEDS
MAKERS OF THE LARGEST GASHOLDER IN THE WORLD ALSO
THE ORIGINAL MAKERS OF
SPIRAL GUIDED GASHOLDERS
MAKERS OF ALL KINDS OF STRUCTURAL IRON & STEEL WORK. STEEL FRAMED BUILDINGS ROOFS RETORT FITTINGS PURIFIERS RETORT LIDS ANTIFREEZERS for Gasholders
STEEL TANKS
OF ALL SIZES
MAKERS OF THE LARGEST IN THE WORLD.
GASHOLDERS
OF EVERY DESCRIPTION & SIZE.
HIGH CLASS BOILERS FITTED WITH DEIGHTON'S PATENT CORRUGATED FLUES.
Telegrams GAS LEEDS. London Office 60 Queen Victoria St E.C.

MANNESMANN

WELDLESS STEEL SPIGOT AND FAUCET PIPES

In Long Lengths up to 35 feet for
GAS & WATER MAINS.

A Perfect Substitute for Cast-Iron Mains.

— THE —
BRITISH MANNESMANN TUBE Co.,
— LIMITED, —
110, CANNON STREET, LONDON, E.C.

R. & J. DEMPSTER, LTD.,

INCREASED CAPACITY
WITH
REDUCED PRESSURE.
LONGER CHARGES.
ORDINARY
GRIDS.

IMPROVEMENTS IN PURIFIERS.

WITH
or WITHOUT
WATER LUTES.
PATENT RUBBER
FASTENING.
SIMPLE VALVES and PIPES.

Write for Particulars.

MANCHESTER.

CLAPHAM BROTHERS LIMITED

WELLINGTON NELSON & MARKET ST. WORKS

KEIGHLEY.

ESTABLISHED 1837.

CLAPHAM'S PATENT "ECLIPSE" SPECIALITIES.

VALVES
LAMP COLUMNS
STRUCTURAL IRON WORK.
RETORT BENCH MOUNTINGS
TANKS.
MAINS.
GIRDERS.
GUTTERS.
CLAPHAM'S PATENT WASHER-SCRUBBER.
CLAPHAM'S PATENT WATER TUBE CONDENSER.

"NEW CENTURY" COVER WITH CLAPHAM'S PATENT JOINT & AUTOMATIC FASTENER FOR DRY-LUTE PURIFIERS.
RETORT MOUTHPIECES, SELF SEALING, HORIZONTAL OR INCLINED.

CONTRACTORS TO HIS MAJESTY'S GOVERNMENT.
LONDON AGENT: T.B. YOUNGER, C.E. 98, GREAT TOWER STREET.

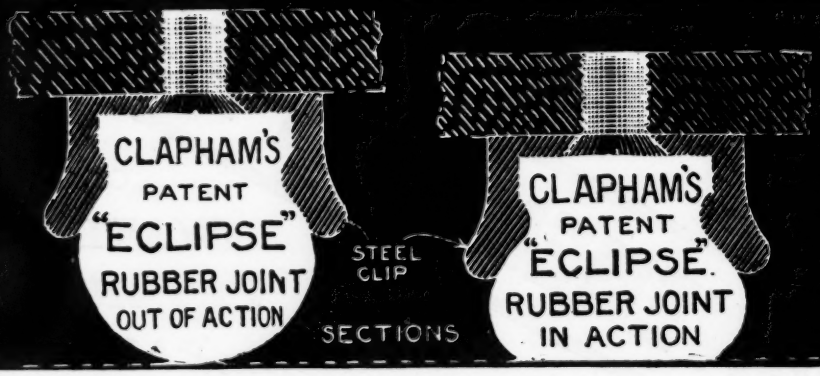
RUBBER JOINT FOR DRY LUTE PURIFIERS.

ALL TROUBLES REMOVED.

PERFECT JOINT SECURED.

ENTIRE SATISFACTION GIVEN.

8578 FT. ORDERED.


CLAPHAM'S PATENT "ECLIPSE" RUBBER JOINT OUT OF ACTION
STEEL CLIP
SECTIONS
CLAPHAM'S PATENT "ECLIPSE" RUBBER JOINT IN ACTION

THE RUBBER DOES NOT HANG IN FESTOONS ON COVERS.

NOR DOES IT STICK TO THE FACE OF PURIFIER BOXES.

SPECIALLY MADE TO RESIST THE ACTION OF GAS.

Supplied to the following Places:

Altrincham, Driffield, Elgin, Hong Kong, Hunstanton, Lancaster, Leeds, Leigh, Manchester, Matlock, New Mills, South Metropolitan (London), South Shields, Smyrna, Tyldesley, Wallasey.

Printed for WALTER KING by King, Sell, & Olding, Ltd.; and Published by him at 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, June 14, 1904.

RICHMOND'S LTD.

MY NAME

IS

"C x x x x x x R."

[*See other side.*

A new departure!
new Cooker!
new name!

RICHMONDS'

"C x x x x x x R."

The illustration on other side, and the first and last letters given, will readily suggest the name we have adopted for a NEW series of STANDARD COOKERS about to be placed on the Market, and we shall

GIVE

THE FIRST COOKER MADE

to the sender of the first opened answer which states correctly the name.

Letters will be opened on

JUNE 21st

and must be addressed thus:—

"COMPETITION,"
The Secretary,
Richmond Gas Stove & Meter Co., Ltd.,
132, Queen Victoria St., London, E.C.

Result will be announced in "Gas Journal" on June 28.

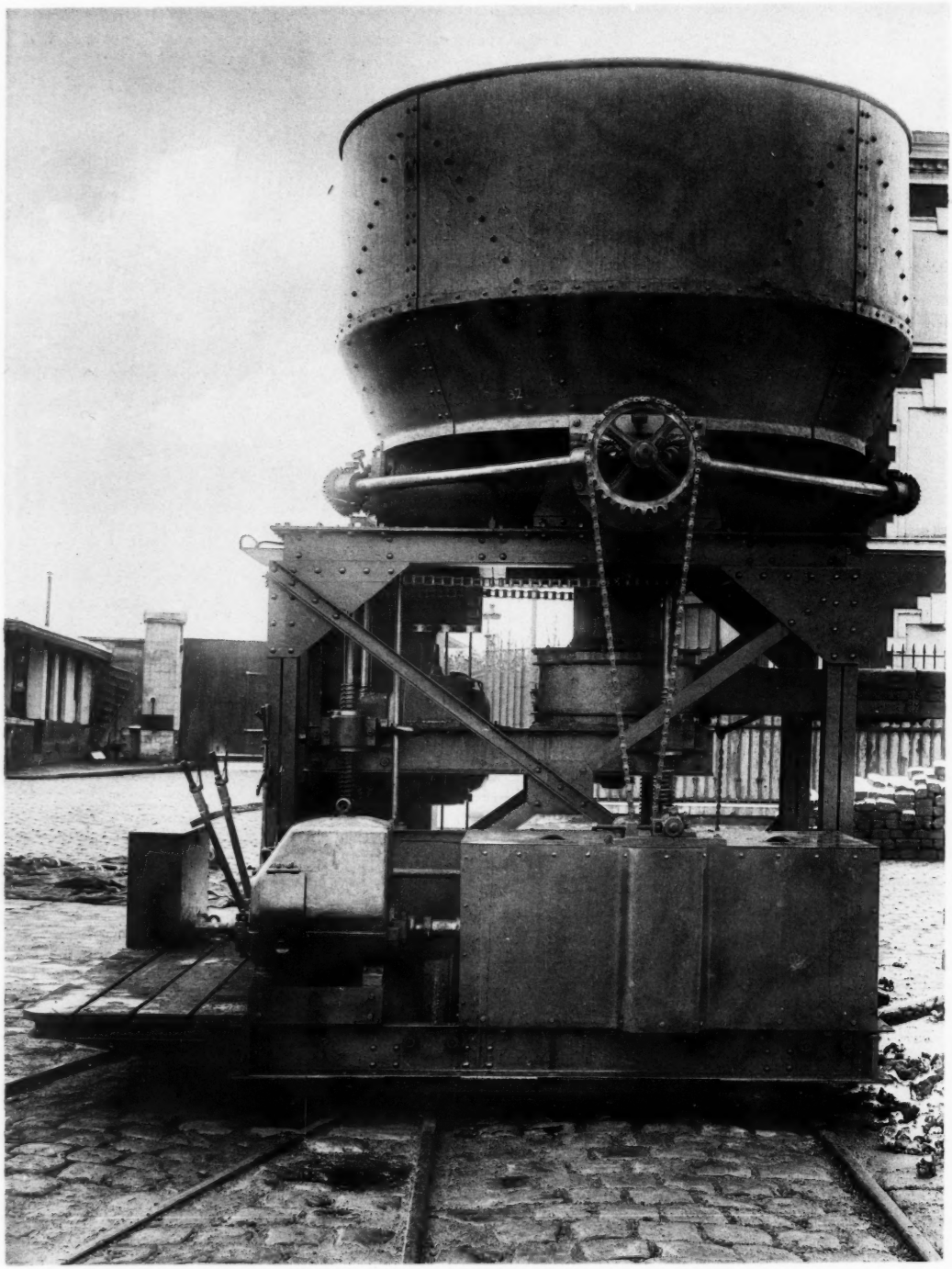
A "Richmond" 2s. Cookery Book will also be sent to all correctly giving name but who are not fortunate enough to have their letter opened first.

Printed for WALTER KING, by King, Sell, and Olding, Ltd.; and published by him at 11, BOLT COURT, FLEET STREET, in the CITY OF LONDON.—Tuesday, June 14, 1904.

THE ELECTRIC TURBINE GAS RETORT CHARGING AND DISCHARGING MACHINE Coy., Ld.

LONDON OFFICE: 106, CANNON STREET, E.C.

Makers: THE WHESSOE FOUNDRY COMPY., LIMD. **Works: DARLINGTON.**



ELECTRIC TURBINE CHARGING MACHINE,

AS MADE FOR

THE GAS LIGHT & COKE COMPANY, BECKTON WORKS.

Charges 20 ft. Retorts evenly from end to end. **Charges can be varied from 5 cwt. to 10 cwt.**

Printed for Walter King, by King, Sell, & Olding, Ltd.; and published by him at 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, June 14, 1904.

Collotype by Waterlow & Sons Ltd.

THE ELECTRIC TURBINE GAS RETORT CHARGING AND DISCHARGING MACHINE Coy., Ld.

LONDON OFFICE 106, CANNON STREET, E.C.

Makers: THE WHESSOE FOUNDRY COMPY., LIMD. **Works: DARLINGTON.**

ELECTRIC DISCHARGING MACHINE,
AS MADE FOR
THE GAS LIGHT & COKE COMPANY, BECKTON WORKS.

Discharges 20 ft. Retorts. **Compact and all parts accessible.**

Printed for Walter King, by King, Sell, & Olding, Ltd.; and published by him at 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, June 14, 1904.

Collotype by Waterlow & Sons Ltd.

Shrewsbury Gas Light Company.

TOP OF SIX PURIFIERS 20'-0" × 15'-0" ON GREE

MADE AND ERECTE

ROBERT DEMPSTER & SON

Printed for Walter King, by King, Sell & Olding, Ltd.; and published by him at 11, Bolt Court, Fleet Street, in the City of Lon

W. BELTON, A.M.I.C.E., ENGINEER.

EEN'S SYSTEM, WITH SUPERSTRUCTURE,
TED IN 1903 BY
NS LTD., ELLAND, YORKS.

ondon.—Tuesday, June 14th, 1904.

Collotype by Waterlow & Sons Ltd.